

User Expertise in Contemporary Information Systems: Conceptualization, Measurement and Application

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Cluster Analysis, Cognitive competence, Enterprise Systems, Expertise, Information Systems, Learning Theory, Self-efficacy, Skill-based, System Success, User Competence

Abstract

The development of user expertise is a strategic imperative for organizations in hyper-competitive markets. This study conceptualizes, operationalises and validates user expertise in contemporary Information Systems (IS) as a formative, multidimensional index. The study commenced by introducing a framework that positioned its concepts against the wealth of studies in the discipline. It then introduces the importance of 'technology centric' approach of expertise, highlighting the differences between Function Information Technology and Enterprise Information Technology, where the focus of this study is on the later domain.

The study derives its constructs through an amalgamation of concept in computer self-efficacy and user competence, deriving a formative model that includes four constructs: skill-based, affective, cognitive, and years of experience. In testing the nomological net of expertise, the study employed knowledge sharing, arguing that experts are more likely to share knowledge with their colleagues. Such a validated and widely accepted index would facilitate progression of past research on user competence and efficacy of IS to complex contemporary IS, while at the same time providing a benchmark for organizations to track their user expertise.

The study employed data gathered from 220 respondents, representing three organizations. The analysis outlines the importance of more generic motivational aspects captured through the 'affective' variable in defining expertise for a contemporary IS, explaining most amount of variance in the latent variable. Cognitive competence and skill-based too were significant contributors and explained adequate amount of variance in the latent construct. Years of experience, a construct considered as important in most domains, was found non-significant.

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STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: QUT Verified Signature

Date: _____01/10/2013_____

CHAPTER 1: INTRODUCTION

This chapter provides a broad overview of the research reported in this thesis and it introduces the research strategy of the thesis. The chapter begins with a discussion on the background and motivations of this research. Next the chapter discusses the significance of the research and the research objectives. The role of self efficacy and user competence is discussed next. This is followed by the hypothesis and research questions. The unit of analysis is discussed next. Then the research context, impact of culture and research design of the study is introduced. This chapter then introduces the preliminary research model. The thesis outline succinctly describes each of the five chapters in this thesis.

BACKGROUND OF THE RESEARCH

An organization's human resources are being recognized as a significant competitive advantage and one of the hidden forces behind profits, growth and lasting value (Pfeffer 1994; Reichheld 1996). As Torraco and Swanson (1995) assert, "Business success increasingly hinges on organization's ability to use its employee's expertise as a factor in shaping of its business strategy" (p 11). It is the knowledge, the skills, and the experience of the organization's human resources – in short its expertise – that has gained recognition and prominence in providing true competitive advantage. Thus, developing employee expertise is a strategic imperative for organizations in hyper-competitive economic environments. In parallel with the continuing investments in complex and costly contemporary Information Systems (IS) – Enterprise Systems (ES) being the quintessence – there has been a growing recognition of the importance of user expertise and user quality on effective adoption of contemporary IS.

User expertise, however, is not a simple reflection of one's innate abilities and capabilities, but rather a combination of acquired complex skills, experience and knowledge capabilities (Ericsson and Smith 1991; Hunt 2006; Norman 2006; Yates and Tschirhart 2006). Eriksson et al. (1993), demonstrate that both extended deliberate practice and deliberate learning of skills have a strong positive relationship with expertise. Simon and Chase (1973), demonstrated that in certain disciplines it takes approximately 10-years of intensive deliberate practice to attain a high degree of proficiency. In Information Systems, research on user competence (e.g. Munro, Huff et al. 1997) and computer self-efficacy (Bandura 1977a; Bandura 1977b; Bandura 1997; Bandura 2007), provide a wealth of knowledge on how to conceptualize and measure 'staff computing ability' (Munro, Huff et al. 1997). Yet, as Marakas et al. (2007) observed, "[past studies on both self-efficacy and user competence] have focused heavily on models in very distinct domains", predominantly using simple information systems (e.g. spreadsheets, word processing) and lacking emphasis on user expertise in contemporary IS.

At a time where organizations are in a transition from in-house, custom-made, stand-alone applications to integrated, complex, customizable, user-centric software packages (Gable, Sedera et al. 2008), it is vital that study re-visits the notions of User Expertise in Contemporary Information Systems. User expertise in contemporary IS could answer why certain users employ only the bare minimum of system features and functions, while others engage in optimal use of a contemporary IS through value-adding usage (Burton-Jones and Straub 2006; Burton-Jones and Gallivan 2007).

This research is designed to conceptualize User Expertise in Contemporary Information Systems as a multi-dimensional formative construct. Through a robust, multi-method study design, using 220 respondents in total representing three organizations in India, the study develops a model for evaluating expertise. This approach employs theoretical foundations of computer self-efficacy and user competence, perceptual measures, its aim being to offer a common instrument that addresses requirements of a contemporary IS in a holistic way. Such a validated and widely-accepted expertise construct has both academic and practical value. Furthermore, using two complementary methods, the study offers a classification method to place users on a continuum based on their expertise, as expert, intermediate or novice. Finally, the study demonstrates the application of this expertise construct in Information System evaluations (IS success), demonstrating that users of different expertise levels evaluate systems differently.

USER EXPERTISE IN CONTEMPORARY IS

In parallel with the proliferation of ES, changing systems landscape of IS, there has been growing recognition of the importance of using systems appropriately for ES lifecycle-wide health and longevity (Seddon, Calvert et al. 2010; Strong and Volkoff 2010). For example, Momoh et al. (2010) attribute a lack of ES benefits to lack of appropriate ES use / lack of user expertise. Furthermore, a recent study by the Standish Group reports that only fewer than 10% of ES installations succeed in using the intended full ES functionality in the early phase of the ES lifecycle due to lack of employee skills. Concomitantly, there have been reports of organizations achieving

high levels of success with ES by focusing on effective use of the system (LeRouge and Webb 2004). Moreover, contemporary system users experience a steep learning curve after ‘going-live’ at the shakedown phase, gaining knowledge of the system features and functions through exploration and undergoing training to add value to their business processes at the later parts of the system lifecycle (i.e. onwards/upwards phase) (Markus and Tanis 2000; Nah, Lau et al. 2001). Users’ expertise with Information Systems has been recognized as crucial of its effect on workplace productivity (Bowen 1986; Magnet 1994; Higginbotham 1997; Little 1997).

Information Systems research addressed this issue of productivity through user expertise, focussing on the adoption and use of IT by end-users (e.g. Davis 1989; Mathieson 1991). IS research has captured such perspectives using computer self efficacy, end user computing and user competence research. Prior research on end user competence and computer self efficacy has made at least two substantial contributions to the IS discipline: (i) recognition of the central role of the end user in deriving value from systems, and (ii) derivation of several frameworks and measurement models to understand fundamental characteristics of end users. However, the current conceptualizations of these topics have not evolved beyond what McAfee (2006) calls as Function IT. Appendix A outlines the differences between Function IT and Enterprise IT (examples include Enterprise Systems, Customer Relationship Management) under four themes.

Thus, new measures and evaluation models are required to gauge the proficiency of users, such as Enterprise Systems (Marakas, Johnson et al. 2007; Gable, Sedera et al. 2008). Nonetheless, most end user computing and computer self efficacy studies continue to rely on instruments and measures that were validated with a far too simplistic view of a complex information system. In example, Munro et al. (1997) observed end user computing using word processing applications, while Marakas et al. (2007) observed computer self efficacy using spreadsheets and word processing applications. Munro et al. (1997) defines user competence stating that “...end users essentially need to know about, and able to use, three things: EUC software, hardware, and concepts and practices. These, then, are the three major EUC

“domains (p 47)”. The Marakas et al. (2007) instrument of computer self efficacy on seven task related constructs focusing on: General efficacy, Windows Efficacy, Spreadsheet Efficacy, Word-Processing Efficacy, Internet Efficacy, Database Efficacy and a test on Task Performance.

Enterprise IT... (1) have multiple user groups using the same system for different purposes, (2) longer lifecycles, where the system use and proficiency could change, (3) introduces continual changes to the organizational structures and business processes, (4) has a process orientation, rather than single-task / functional nature, (5) users do not require technical knowledge (e. g. server aspects), as such tasks are done by dedicated technical staff. Given the substantial differences between Function IT and Enterprise IT, it is essential that one understands how expertise can be characterized in contemporary Enterprise IT.

In figure 1, cells marked with ‘A’ denote where past studies of computer user competence concentrate on, whereas the cells marked as ‘B’ provide the scope for this research. The scope (i.e. cells) must be selected with care, understanding the intent of the study context, acknowledging that some combinations of cells are less realistic and less informative. The study recommends that the primary consideration herein should be the type of the system. Thus, as a rule-of-thumb, the study suggests that the selection of cells be based, first on the system, next the domains, and finally the measurement approach.

As such, this study ‘by-design’ is scoped to address the areas marked as ‘B’ in the conceptual framework. It is recognized that it would have been best to have conducted the study over multiple axis for comparative purposes. This would have helped increase generalizability of the findings. Future studies could benefit by doing this. For example, future studies could extend the evaluation method to both self-evaluation as well as the classical method.

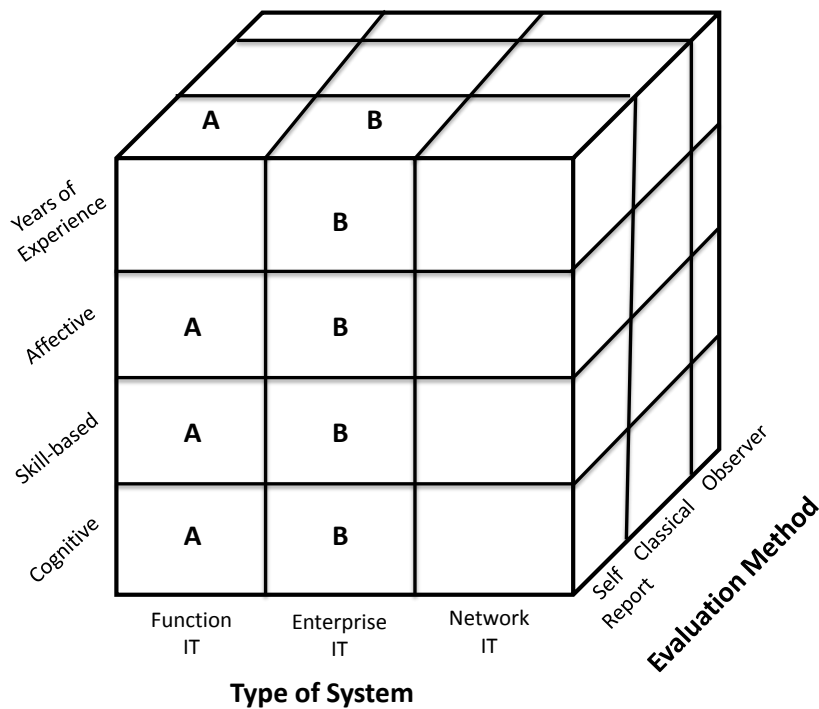


Figure 1: Expertise Framework

The system centric approach is central to this study approach given that the selection of the system (x-axis of the cube labelled as “Type of System”) influences the selection of appropriate measures. In other words, the primary measure of selection.

As we noted in Appendix A, Enterprise Systems have the following characteristics that differ from Function IT. They include: (i) Enterprise IT cannot be adopted without complements, (ii) Contextual changes vary the way we use Enterprise IT, (iii) Prior knowledge is essential, and (iv) Proficiency changes over time / across user cohorts. Thus, the preposition in this thesis is such that we must consider these implications first, before developing measures for expertise.

For example, in relation to the first difference on ‘adopting with complements, it is clear that all Enterprise Systems cause organization to ‘re-design processes’ and introduce ‘new decision rights’. On the other hand, and consistent with McAfee’s arguments, Function IT (e.g. word processing) can be adopted by the user without any substantial organizational innovation and changes. As such, adoption of Function IT does not entail process re-designs or new decision rights (as opposed to Enterprise IT). Similarly, either the context of adoption or the evolution of skills over time is not evident in Function IT system users. For example, MS WORD® will work in exactly

the same way, if we adopt in an oil and gas company or in an organization dealing with higher education. Yet, in Enterprise IT, the context will change the way a system is configured and the features and functions of the system. Similarly, it is highly unlikely that user of a Function IT system makes significant increases to knowledge, after gaining familiarity of the basic, and day-to-day functions. Yet, the learning curve of an Enterprise IT is steeper, longer and is incremental. Finally, most ES operational and management users do not have prior knowledge of Enterprise Systems. Even if they have some amount of experience, given the contextual differences (factor (ii) in the list above), prior knowledge cannot be easily employable.

Underlying in the discussion above is the differences in “the system”, which would make a substantial difference in their expertise (and their degree of proficiency). The aforementioned justifies the “system centric” view of expertise. The detailed discussion of each axis (i.e. type of system, measurement construct and evaluation method) and their values are described in details in chapter 3, figure 8, page 44.

SIGNIFICANCE OF THIS STUDY

This study seeks to conceptualize measure and apply the notion of Contemporary Information Systems User Expertise. The study model is developed using a conceptual framework highlighting and re-visiting the notions of user expertise in Contemporary IS, through past studies on Computer Self-Efficacy and User Competence. It was noted that most past studies of computer self-efficacy and user competence focus on function IT (e.g. spreadsheets and word processing as common examples), highlighting the need to re-conceptualize user expertise of a complex, contemporary, and organizational-wide Information System (where Enterprise System is an archetype of). As Marakas (2007) highlight “...for business and information systems, real world tasks are neither simple nor single domain focussed. Rather, they often draw on multiple skill sets and require an individual to be able to perform tasks that span several skill domains... (p40)”. In this study conceptualization, measurement and application of Contemporary Information Systems User Expertise are driven to address this gap in research.

This research conceives both the model constructs and its measures as formative, manifested in extensive attention to the completeness and necessity of constructs and measures of expertise. In order to ensure this, the expertise model specification and validation proceeded from an inclusive view of expertise, commencing with the three theoretical foundations of theories of learning (Kraiger, Ford et al. 1993), employed in past studies. Conceived primarily through a ‘system centric’ viewpoint, the study presented a conceptual framework for which IS expertise can be understood. The index of expertise will encourage future researchers to continue a cumulative tradition of research and to further extend the understanding of user expertise in contemporary Information Systems.

The study approach and findings make a significant contribution to system success as well. This study employs the classifications developed through the expertise model to understand how cohorts of different expertise perceive system success differently. Despite three decades of studies on Information System Success (DeLone and McLean 1992; 2003; Gable, Sedera et al. 2008), none of the system evaluation studies to-date has considered respondents’ expertise in their evaluations.

THE RESEARCH OBJECTIVES

The primary objective of the study is to identify and validate a set of qualities that would usefully capture expertise of an individual in the context of Information Systems. The study would not intentionally prepare qualities of expertise for each and every position or role in the context of IS. Such a detailed approach would be too detailed to execute and repeat and would not gain the benefits of generalization and repeatability. Thus, the objective of the study is to derive the salient generic qualities of expertise which individuals can use to relate to their specific roles and positions when answering the survey questions. It is believed that such an approach would not only yield useful information, but also allows a cumulative practice in research and practice. Once the salient characteristics are identified, the study will then apply the classification of expertise of IS in a system evaluation.

When deriving the salient characteristics, the study is designed to take advantage of the existing literature on expertise in social psychology and prior research on end user competence and computer self efficacy. Therefore, a thorough literature review (chapter 2) has been conducted to identify the salient characteristics of an expert in IS.

Once the salient characteristics are identified, the guidelines are then used in an IS evaluation to determine whether the classifications according to the varying levels of expertise (novice, intermediate and expert) adds further value in IS success evaluations, for which this research employs the IS-Impact measurement model of Gable Sedera and Chan (2008) using the prior validated 27 measures.

This research study has three main interrelated aims: (1) identify the characteristics of expertise (2) validate a maximally generalisable expertise measurement model; and (3) the three groups based on their levels of expertise, has different views in system evaluations. This research does not propose a means of how a novice could become an expert (highest level of expertise).

THE ROLE OF SELF-EFFICACY AND USER COMPETENCE

As researchers note that, becoming an expert in the 21st century professional workplace involves a complex array of knowledge and skills as well as processes (Feltovich, Spiro et al. 1997; Yates and Tschirhart 2006). Past research contend that, this new workplace emphasises on such things as the need for dealing with deep understanding, the ubiquity of change and novelty, the simultaneous occurrence of processes, the interactiveness and interdependence of processes and people, the demand for customisation/particularisation in both products and procedures, non-hierarchical-linear management structures and the like (Davenport, 1998). The intension herein is to employ Bandura's and related work by others as the foundation and then to develop constructs and measures related to contemporary Information Systems expertise considering both cognitive skills as well as their ability to adapt and adopt to new situations.

Thus, this study employs two theoretical foundations to provide guidance in developing the construct for Expertise. The two theoretical foundations – (i) self-efficacy and (ii) user competence – provide complementary views that jointly make the new expertise construct more meaningful to the context of contemporary IS.

As mentioned earlier, both computer self-efficacy and user competence have provided a wealth of studies on how we could assess ones capabilities and potentials.

The concept of ‘expertise’ is an amalgam of the two concepts, in that it attempts to identify the high-level attitudes and beliefs important for ES expertise through the theory of self-efficacy. The constructs of user competence (akin to learning theory) provides specific knowledge and skill-based constructs for expertise. The section below, not intended to introduce each theory in full, demonstrates how each theory contributes to the overall objective of developing a scale for Expertise.

The theory of self-efficacy is concerned with people’s beliefs in their capabilities to produce given attainments (Bandura 1997). In other words, it focuses on the belief that one will have on his/her capabilities. In this research, the construct “Affective” is aligned with self-efficacy (see figure 1). Bandura (2006) acknowledges the role of higher-order self-regulatory skills, like “affective” – measured in general through variables relating to one’s motivation.

Bandura (2006; page 208) notes that “...when different spheres of activity are governed by similar sub-skills there is some inter-domain relation in perceived efficacy. Proficient performance is partly guided by higher-order self-regulatory skills”. These include generic skills for diagnosing task demands, constructing and evaluating alternative courses of action, setting proximal goals to guide one’s efforts, and creating self-incentives to sustain engagement in taxing activities and to manage stress and debilitating intrusive thoughts (Bandura 1997). In general, the self-efficacy construct reflects ones’ perceived skills and ability, including motivational and ability to adapt to the work environments as well (Wood and Bandura 1989; Gist and Mitchell 1992). Thus, the construct ‘Affective’ is employed to capture this high-order notion in relation to Expertise in Contemporary IS.

On the other hand, User Competence studies specify lower level constructs that are directly related to ones employment. Past studies measured user competence employing two constructs: “Skill-Based” and “Cognitive” (e.g. Marcolin, Compeau et al. 2000). Implied in User Competence is that the construct is measured employing

the “known” tasks or activities. For example, Marcolin et al. (2000) observed user competence of Spreadsheets and Word Processing, focusing on specific functions that users perform within the software (e.g. formatting).

In derivation of items and measurement too the approaches of Self-Efficacy and User Competence have similarities.

In designing measures for self-efficacy, Bandura (2006; page 207) states “...there is no all-purpose measure of perceived self-efficacy. The “one measure fits all” approach usually has limited explanatory and predictive value because most of the items in an all-purpose test may have little or no relevance to the domain of functioning. Moreover, in an effort to serve all purposes, items in such a measure are usually cast in general terms divorced from the situational demands and circumstances. This leaves much ambiguity about exactly what is being measured or the level of task and situational demands that must be managed. Scales of perceived self-efficacy must be tailored to the particular domain of functioning that is the object of interest. Thus the measures of ‘affective’ were derived using the key high-level premises of Enterprise Systems, observing whether the users are able to withstand and are motivated to change and evolve with the evolution of the Enterprise System. The measures of skill-based and cognitive were developed using the studies of User Competence (e.g. Marcolin et al. 2000).

HYPOTHESIS AND RESEARCH QUESTIONS

The main hypothesis of the study is that Information Systems users have significantly different levels of expertise, and that they can be usefully classified according to their degree of proficiency. Thus, it was also expected, if the derived classification is correct and meaningful, the evaluations that they make of a system are also significantly different. The study design and the research model have been derived to accommodate the hypothesis.

Two research questions have been derived to achieve the objectives of this study.

(1) What are the salient characteristics of user expertise in contemporary Information Systems, where Enterprise Systems is an archetype of?

(2) Do respondents of different levels of expertise demonstrate statistically significant differences in their system evaluations in contemporary Information Systems, where Enterprise Systems is an archetype of?

In seeking answers for the first research question, this research attempts to derive the possible characteristics of expertise to an a-priori model and then distil the salient characteristics through empirical validation. The possible characteristics of expertise are derived through a cross-discipline literature review that focuses on Information System studies of user competence (Bandura 1977a; Bandura 1977b; Bandura 1997; Munro 1997; Bandura 2007), computer self efficacy (Bandura 1986; Marakas, Johnson et al. 2007), psychology studies of expertise (Chase and Simon 1973; Ericsson and Smith 1991; Hunt 2006) and knowledge management literature in the discipline of Information Systems (Davenport 1998).

In answering the first research question, this research makes references to computer self efficacy and user competence studies. Especially, the study employs the three constructs of 1) cognitive competence 2) skill-based and 3) affective. The types of cognitive aspects related to the study are understood from the viewpoint of Davenport (1998) and Sedera and Gable (2010); where the three knowledge types specific to Enterprise Systems were identified. They include 1) software specific knowledge, 2) business process knowledge and 3) organization specific knowledge.

Despite the wealth of research on user competence, self efficacy and related topics, research has less knowledge of how to classify users based on expertise. This research attempts to fill this void by using data analysis triangulation (discussed in chapter 4).

The second research question derives its answers through the application of the classifications of expertise derived through the first research question. Herein, the

objective is to understand whether groups of respondents derived according to their expertise demonstrate statistically significant differences on the dimensions and measures of the IS-Impact measurement model.

UNIT OF ANALYSIS

Pinsonneault and Kraemer (1993) classified the types of unit of analysis: 1) individual, 2) work group, 3) department, 4) organisation, 5) application and 6) project. Given the research constructs will be gathering expertise levels from individuals, the unit of analysis in this research is the *Individual User* in a particular organisation using an operational Information System.

The selection of the *individual users* as the unit of analysis is consistent with the intended application of the expertise model in the context of system evaluations as well. The IS-Impact measurement model too requires that responses are gathered at the individual level on their assessment of an operational Information System.

The *individual users* of this study must have substantial direct exposure to the operational Information System (in this case, data was gathered from operational Enterprise System applications). Since the strategic Management do not receive adequate direct exposure to the operational system, they are excluded from this study. As expected, external user cohorts like suppliers and customers were also eliminated from the scope of the study.

THE RESEARCH CONTEXT

Given the background, motivations, research questions and the unit of analysis, this research requires quantitative data from a reasonably large sample of regular users of an operational Information System. It was also given consideration to select respondents from the same IS application to avoid any extraneous influence on the data analysis.

Thus, three medium sized organizations located in India were selected for the data collection. The three organizations were selected given that they had implemented the same enterprise wide software – SAP – and were located in the same geographical region. Due to ethical agreements between the Queensland University of Technology and the organizations, their names are replaced with pseudonyms.

Pharma 1: This is one of the largest pharmaceutical companies in India, with annual domestic sales exceeding USD 300 million. It has manufacturing operations in number of countries in Europe, US & Africa. It uses SAP Logistics, which was implemented in 2007. Pharma 1 includes approximately 100 SAP concurrent users.

Glass: Glass is the leading manufacturer of glass bottles for medical, cosmetics & beverage industry in India. They too implemented SAP Logistics in 2007 and include approximately 100 concurrent SAP users.

Pharma 2: Pharma 2 is another leading pharmaceutical company in India. This company is listed in Paris and New York stock exchanges. The Indian operations of Pharma 2 have annual sales over USD 240 million with manufacturing plants in two locations. Pharma 2 also uses SAP Logistics with approximately 150 SAP concurrent users. They completed their implementation in 2002.

All three organizations provide a relatively homogenous background for the research data collection. Having past a minimum of three years since their implementation, the context provides an ideal environment to investigate the two research questions.

IMPACT OF CULTURE

All three organizations representing India may introduce some elements of bias through cultural influence. As per Hofstede (information available through <http://geert-hofstede.com>) culture can be analyzed using five dimensions: (i) power distance, (ii) individualism, (iii) masculinity, (iv) uncertainty avoidance, and (v) long-

term orientation. Using the figure below, accessed through <http://geert-hofstede.com>, the following argument is developed. The fundamental question here is *not* whether India and other nations differ in their cultures (which is clearly evident in figure 2), but more importantly, whether the *culture* influences the derived measures and constructs.

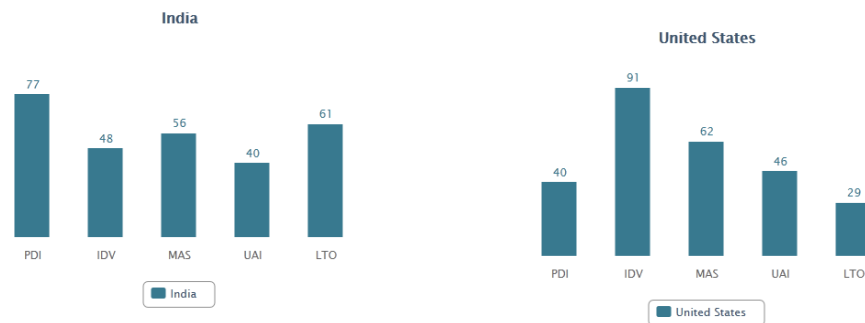


Figure 2: Culture of India vs. USA

Observing the descriptions for each of the constructs that Hofstede describes “Culture” with (i.e. power distance, individualism, masculinity, uncertainty avoidance, and long-term orientation), two types of possible influences are observed: (i) it can be argued that these five aspects may have a bearing on how one evaluates him/her-self through self-evaluation mechanism employed in this study, and (ii) impact of the five factors of culture on the possible antecedents and / or consequences of expertise.

For example, ‘power distance’ and ‘masculinity’ may lead to employees at higher levels of male staff placing a higher weightage on their self-assessments respectively. On the other hand, high individualism and long term orientation are likely to influence the antecedents and / or consequences of expertise. Knowledge sharing, for example, is likely to be influenced by the individualism and perceived power distance.

Despite the influence of culture on the relative weights and its nomological net, culture is unlikely to influence the construct it-self. In other words, the four constructs validated in this study would still make their statistically significant contribution. In a similar manner, one could use the GLOBE measures of House (2004) to understand the impact of national culture on our perceptions of the influence of national culture on system evaluations and expertise.

THE RESEARCH DESIGN

The figure below depicts the design of this research through research strategy exploration to findings and interpretation. There are five stages in the research design: Literature review (chapter 2), Mapping (chapter 3), Survey (chapter 4) and Confirmatory Validation (chapter 4).

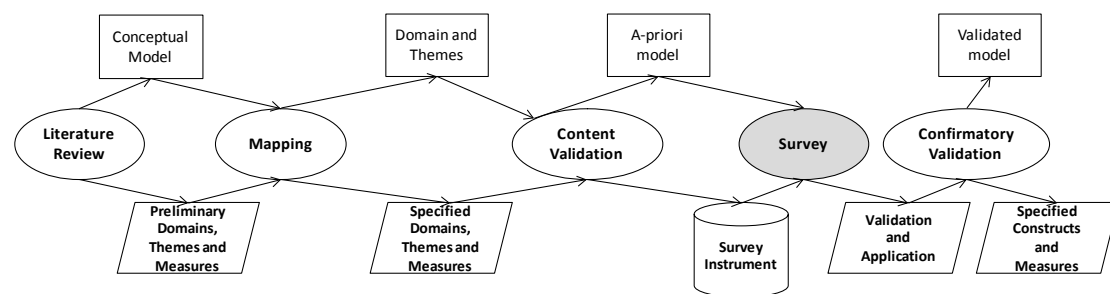


Figure 3: Research Design

THE PRELIMINARY RESEARCH MODEL

The preliminary research model is depicted in the figure below. It denotes the central focus of the study on expertise and the application of the expertise model through the employment of the IS-Impact measurement model. The a-priori expertise model includes constructs such as (1) Cognitive Competence, (2) Skill-Based, (3) Affective, and (4) Years of Experience.

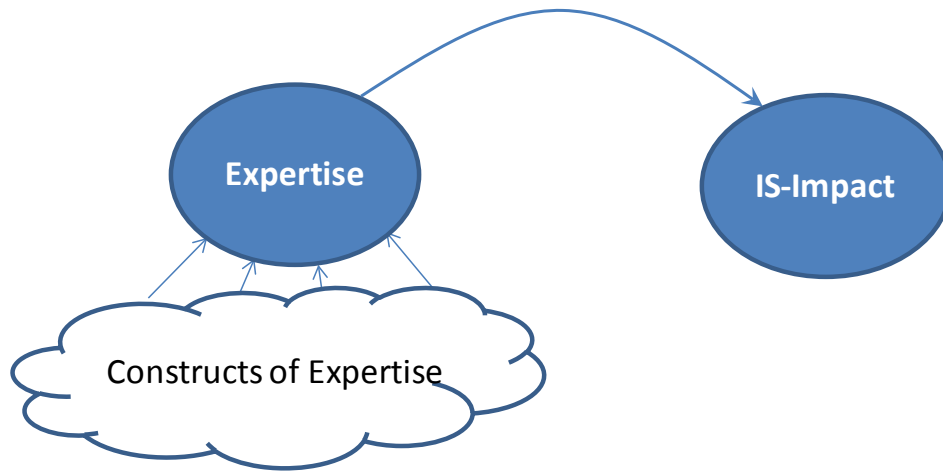


Figure 4: The conceptual model

The path in the diagram does not depict causality or process nature between the two key constructs. Instead, it simply highlights how the expertise model is applied in the context of IS success / evaluations.

As discussed earlier, both constructs are conceived as formative. As per the Petter et al. (2007) guidelines for identifying formative variables, all a-priori measures of expertise; (i) need not co-vary, (ii) are not interchangeable, (iii) cause the core-construct as opposed to being caused by it, and (iv) may have different antecedents and consequences in potentially quite different nomological nets.

CHAPTER SUMMARY

This research study has three main, interrelated aims: (1) define the salient characteristics of expertise in Information Systems relevant for system evaluation, (2) derive a formative model of Expertise (also referred to herein as degree of proficiency). Using the expertise model, this study will derive three mutually exclusive respondent groups for evaluation of a contemporary Information System (IS); and (3) in order to validate the salience of the derived respondent groups' characteristics, the three groups, Expert, Intermediate and Novice, are then applied in the context of Information Systems evaluation using the IS-Impact measurement model (Gable, Sedera et al. 2008).

THESIS OUTLINE

This thesis is structured in the following manner. The significance of the research and research gaps were introduced in chapter 1. In addition, chapter 1 also *introduced* the key constructs of the study. The review of literature reported in Chapter 2 will next provide an in-depth discussion of those key constructs introduced in chapter 1 and chapter 3 will demonstrate how the expertise model has been operationalized in the current study context. Given this approach, I acknowledge that certain aspects in relation to the model constructs will repeat. But this approach was taken after careful considerations with the interest of clarity and better understanding through cumulative knowledge in mind.

Chapter 2: Literature review

This chapter reports the results of the literature relevant to this research. The literature review presented herein evaluates prior work to provide a background of the key concepts researched in this study.

Chapter 3: Research Model Development

This chapter begins with a discussion of the conceptual model that was introduced in chapter 1. The key constructs of the conceptual model and the arguments presented herein lead to the a-priori model.

Chapter 4: Data Analysis

This chapter describes the quantitative analysis including empirical results and hypotheses tests. The chapter is divided into the following sections. The first part focuses on descriptive statistics. In the next section, the structural model including nomological validity is explained. Subsequently the study conducts the “application study” to uncover the findings that are valuable to this research and discuss the research findings.

Chapter 5: Conclusions, Implications and Limitations

This chapter summarizes the research related works, and outlines possible contributions, limitations and suggests follow-on works. It begins with a summary of the research, and subsequently addresses the generalizability of the findings.

CHAPTER 2: INTRODUCTION

This chapter reports the results of the literature relevant to this research. The literature review presented herein evaluates prior work to provide a background of the key concepts researched in this study. The literature review has eight (8) main objectives: (1) to help the candidate determine and articulate the current level of knowledge and to assess where the further research is required, (2) to aid in identifying the salient characteristics of Expertise, (3) to identify issues and ‘gaps’ in the existing literature, (4) to introduce theory which usefully relate to the explanation of the key constructs, (5) to serve as a source of explanation of phenomena observed in model and hypotheses testing, (6) to develop candidate’s research skills, to do environmental scans, to read in a targeted way, (7) to develop candidate’s skills of critical appraisal and your capacity to identify the objectives and arguments of those you are reading, and to articulate their strengths and weaknesses and (8) to think laterally and creatively about future potential research areas.

The objective of the literature review is to develop an appreciation of the current body of knowledge in relation to the notion of expertise and how it relates to system success. The understanding that is developed through the past body of knowledge is then employed in chapter 3 against our pragmatic approach of understanding expertise of an Enterprise System. As such, our definition of expertise will be informed and formulated by the literature and then be improved for the current context. This would allow the researcher to compare prior definitions and constructs of expertise, and then demonstrate their validity and generalizability to the new study context.

By expanding the research design provided in Chapter 1, figure 5 depicts the literature review process in detail. The process of searching for relevant literature was carried out in six (6) stages. In the first stage the study defined the research strategy to find appropriate sources for this study. The strategy included identifying top refereed journals in the information system area such as MIS Quarterly, Journal of the Association of IS, Information and Management, Journal of MIS, Information Systems Research and others from popular databases ProQuest and Science Direct.

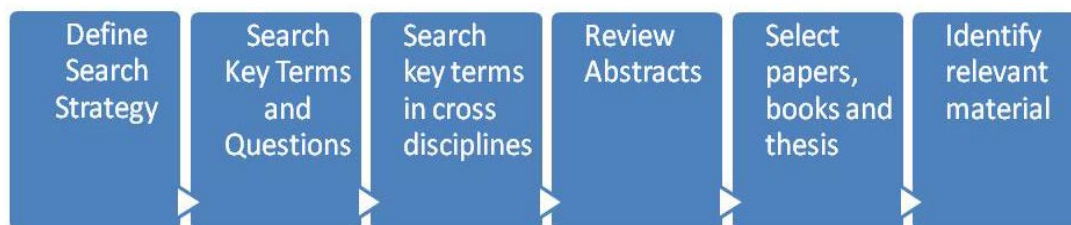


Figure 5: Literature Review Design

The A-ranking conferences in IS were also considered and prioritised, including the International Conference on Information Systems, Pacific Asia Conference on Information Systems, European Conference on Information Systems, and Australian conference on Information Systems. In the second stage, the study searched the literature by using key questions and terms. For example, papers were searched by the use of search terms including “Experts”, “Expertise”, “User Competence”, “User Expertise”, “Self-Efficacy”, “End User Computing”, “Computer Self-Efficacy” and “Degree of Proficiency”. In the next phase it was searched cross disciplinary literature (Psychology and Sociology) using the search terms “Expertise”, “Expert” and “Degree of Proficiency”. In these disciplines “Expertise” has been researched extensively. In the fourth stage, abstracts from the collected papers were reviewed in order to ensure that the study captured the issues relevant to this research topic, and to eliminate any irrelevant material. In the next stage, all the appropriate papers, books and theses and other resources including soft copies and hard copies were selected. Finally, in the sixth stage, every source that provided evidence relevant to the key questions, terms and concepts were gathered to ensure all the relevant literature was adequately covered.

The review of literature is arranged in the following manner:

1. **Motivations of the study:** The study objective was initiated to better understand Information Systems Evaluations. As mentioned in chapter 1, the second hypothesis is based on the premise that the respondents classified according to their expertise may provide statistically significant differences for the dimensions of system success. Given this focus, this study summarizes a selection of past studies of IS success and the stakeholder perspectives. This archival analysis also helped to understand the key employment cohorts of a complex Enterprise Resource Planning system.
2. **Defining Expertise:** This section summarizes the definitions of past studies on expertise, and its core characteristics. Also discussed therein is a review of what the past studies have discussed in relation to the seemingly tautological classification of expertise into a continuum of expert, intermediate and novice. This section will also introduce the most commonly used classification for expertise – the years of experience.
3. **Analogues Theories:** As mentioned, there are two main parallel disciplines to the notion of expertise: Computer Self Efficacy and User Competence. Such literature provides much needed theoretical background for the current study, helping to formulate the research framework (figure 1).
4. **Application Context:** The expertise classification derived through the expertise method will be applied in a contemporary IS to see whether the cohorts derived through expertise model demonstrate statistically significant differences in their evaluations. Thus, gaining an understanding of the IS success literature and Enterprise Systems, as the contemporary IS, was deemed essential. Herein, the review includes the IS Impact model and explains the relevant aspects of Enterprise Systems.

Motivations of the study

The respondents' 'Perspective on measurement' is an important design consideration that is fundamental to this study. Especially, Enterprise Systems (ES), unlike a traditional Information System, entail multiple stakeholder groups ranging from top executives to data entry operators, with diverse skills, knowledge and experience. Given the diversity of their characteristics, they may evaluate the 'same' system differently. Thus, the importance of

analyzing ‘success’ at multiple cohorts has been discussed amongst academics for several decades, yet with no clear consensus on how to classify employment cohorts usefully for system evaluations. Furthermore, there is no universal agreement on what employment cohorts should be canvassed.

This review below seeks to identify the salient stakeholders of ES and illustrate the importance of assessing ES-success from multiple perspectives. The two-phased study analyses data of 310 respondents and examines 81 IS-success studies. The study identifies three key employment cohorts in the context of ES and highlights the importance of measuring ES-success from a multi-stakeholder view point.

The importance of gathering perceptions of success at multiple levels in organizations has been discussed among academics for several decades (e.g. Cameron and Whetten 1983; Leidner and Elam 1994; Tallon, Kraemer et al. 2000; Sedera and Gable 2004). An Enterprise System, unlike a traditional Information System, entails many ‘users’ ranging from top executives to data entry operators. These stakeholders (henceforth referred to as the *employment cohorts due to the intra-organizational focus*) typically have multiple and often conflicting objectives and priorities and rarely agree on a set of common aims (e.g. Cameron and Whetten 1983; Quinn and Rohrbaugh 1983; Yoon 1995). However, there is no universal agreement on what employment cohorts should be canvassed (i.e. which are the distinctive employment cohorts?). Contemporary IS-success studies have used various employment cohorts making it difficult to generalize the findings and impossible to make comparisons.

The purpose of this literature review is to understand prior studies that had helped to identify the employment cohorts used in the IS-success studies. As expected, it was noted that the discussions of the employment cohorts are deep-rooted in management literature, than in the IS literature. The employment cohorts identified in the literature below, together with their descriptions, were used in the content analysis and the empirical statistical data analysis.

1. Anthony (1965) provided the main foundations for employment cohort classification in management science. He referred to three levels of employment in an organization; (1) *Strategic*, (2) *Management* and (3) *Operational*. The Strategic level focuses on deciding organizational-wide objectives and allocates necessary resources to achieve the objectives. The Strategic level is involved in complex, irregular decision making and focuses on providing policies to govern the entire organization. At the Strategic level, information requirements are ad-

hoc in nature and there is reliance on predictive information for long term organizational goals. At the management level, information requirements are focused on assuring that the resources, both human and financial, are used effectively and efficiently to accomplish goals stated at the Strategic level. The characteristics of information required by the management level are different to those required at the Strategic level. The management level deals with rhythmic (but not repetitive) and prescribed procedures. Managers tend to prefer integrated, procedural information that is for a precise task. Furthermore, managers tend to prefer 'goal congruent' information systems. At the Operational level, employees are involved in highly structured and specific tasks that are routine and transactional. Tasks carried out at the Operational level are precise and are governed by the organizational rules and procedures. The Operational level tends to deal with real time data focused on individual events with little or no emphasis on key organizational performance indicators. The three levels of employment introduced by (Anthony 1965) tend to be hierarchical on several dimensions: (1) time span of decisions (i.e. long, medium and short term), (2) importance of a single action (i.e. critical, important and common) and (3) the level of judgment (i.e. strong, moderate and modest). In relation to contemporary IS like Enterprise Systems, the operational staff engages with the system as a Transaction Processing System on a daily-basis, Management Staff interact with the system as a Management Information System and the Strategic Staff uses the system sporadically as an Executing Information System.

Singleton, Mclean et al. (1988) used the employment classification of Anthony (1965) and concluded that contemporary organizations need a 'shared vision' across the ranks of employment. Furthermore, they emphasized the importance of gathering information from all employment levels to evaluate a portfolio of Information Systems. Studies reported (Alloway and Quillard 1983; Seddon, Calvert et al. 2010; Strong and Volkoff 2010) reported that 79% of frequently used management support systems relied heavily on underlying transaction processing systems. Cheney and Dickson (1982) found differences in levels of satisfaction across the employment cohorts. Vlahos and Ferratt (1995) studied perceived value, use of information systems and satisfaction levels across employment cohorts. They found that the

‘line employees’ (similar to Operational level of Anthony, (1965)) have a higher satisfaction levels compared to the management and Strategic levels. Furthermore, the Vlahos and Farret (1995) study found higher satisfaction levels among Technical support staff.

In the Enterprise Systems implementation success literature, (Bancroft, Seip et al. 1998) identified, (1) effective communication across the employees of the organization, (2) selecting a balanced implementation team, and (3) providing adequate training for employees at all level of the organization as important success factors, emphasizing the importance of full representativeness across the employment cohorts. Wu, Wang et al. (2002) examined satisfaction levels of Enterprise System users in Taiwan. They identified two main classes of stakeholders in Enterprise Systems implementations: an internal project team and an external contractor. Their research was conducted within the internal implementation team focusing on top managers, key users, end users and the MIS staff. Wu et al. (2002) found that in several areas, key users and end users have relatively low levels of satisfaction. Singletary et al. (2003) analyzed qualitative data to illustrate the importance of gathering views on ES-success at different levels in organizations. The three Enterprise Systems employment cohorts they established were (1) managers, (2) IT professionals and (3) end users. (Shang and Seddon (2000; 2002) introduced one of few existing Enterprise Systems benefits frameworks after completing in-depth case studies of four Australian utility companies.

The Shang and Seddon framework classifies potential Enterprise Systems benefits into 21 lower level measures organized around 5 main categories: Operational benefits, managerial benefits, strategic benefits, IT infrastructure benefits and organizational benefits. The strategic benefits in the Shang and Seddon (2000) ERP benefits framework relate to the Strategic level of Anthony’s (1965) classification, while the operational and managerial benefits are related to the Operational and Management levels. The identification of the IT infrastructure benefits is an important contribution of the Shang and Seddon ERP benefits framework, highlighting the IT benefits that Enterprise Systems generate to an organization. Shang and Seddon (2000; 2002) and Singletary, Pawlowski et al. (2003) identify Technical staff as a distinct and important employment cohort in Enterprise Systems evaluations. Furthermore, literature suggests that the management level employees as the most appropriate cohort from which to gather perceptions of Enterprise Systems benefits. To the contrary, Tallon, Kraemer et al. (2000) highlighted the importance of capturing intangible benefits of

Enterprise System, proposing Strategic managers as the most appropriate single employment cohort.

In summary, the review of related literature identified four employment cohorts applicable to IS: (1) Strategic, (2) Management, (3) Operational and (4) Technical. The review strongly advocated gathering data from all employment cohorts in IS-success. Moreover, the literature review provided characteristics of each employment cohort and helped to derive guidelines for identifying them in a large multi-respondent data analysis. Appendix B reports the findings of a content analysis that includes 81 IS-success studies reported between 1990 and 2005. It identifies the perspectives employed in past IS-success studies, highlighting the weaknesses of past system evaluation studies.

Definitions of Expert/Expertise

Prior research suggests that ‘expertise’ is not a simple reflection of one’s innate abilities and capabilities, but rather a combination of acquired complex skills, experience and knowledge capabilities (Ericsson and Smith 1991; Hunt 2006; Norman 2006; Yates and Tschirhart 2006). Foundational work by Eriksson et al. (1993), demonstrates that both extended deliberate practice and deliberate learning of skills have a strong positive relationship with individual performance.

Despite its widespread use, the term ‘expertise’ has been rarely defined in past IS studies. Thus, this study derives definitions through analogues research domains. These definitions help this research form its notion of expertise, recognizing that expertise in a contemporary IS is vastly different to those of other disciplines.

One of the earliest characterizations of expertise is derived through the work of Chase and Simon (1973). They believed that the attainment by experts of many other forms of expertise, in fact “any skilled activity (e.g. Football, music)”, was the result of acquiring, during many years of experience in their domain, vast amounts of knowledge and the ability to perform pattern-based retrieval”. Though their definition and characterization highlights that one does not have to have innate expertise and that longer repetitive behaviour could lead to some level of expertise, they fail to recognize the dynamism of the discipline / area where the expertise is sought. Frensch and Sternberg (1989) concur with Chase and Simon (1973)

and explained expertise as an ability acquired by practice to perform qualitatively well in a particular task domain.

Surprisingly, in recent times, Petcovic et al. (2007) defined an expert using the same definitions stating that an expert is an individual with the highest level of expertise of the domain and is someone who has spent many hours training or solving problems in a specific domain.

To the contrary, Feltovich et al. (1997) explained that, becoming an expert in the 21st century professional workplace involves a complex array of knowledge and skills as well as processes. The authors contend that, “the new workplace emphasises such things as the need for dealing with deep understanding, the ubiquity of change and novelty, the simultaneous occurrence of processes, the interactiveness and interdependence of processes and people, the demand for customisation/particularisation in both products and procedures, non-hierarchical-linear management structures and the like”.

Swanson and Holton (2001) agree with Feltovich et al. (1997) observations of expertise, as an expert “displays behaviour within a specialised domain and/or related domain in the form of consistently demonstrated actions of an individual that are both optimally efficient in their execution and effective in their results”. Their hypothesised dimensions of expertise include problem-solving skills, experience, and knowledge. The authors consider the concept to be dynamic and domain-specific.

Eraut (1994) defined Expertise through models of progression from novice to expert, through a correspondence between cognitive processes and the characteristics of the task, or through processes of developing professional creativity and intuitive capacity in problematic situations.

Several researchers identify the composition of expertise. In other words, what constitutes expertise of a person in a given discipline? According to Cornford and Athanasou (1995) an expert goes beyond just being competent. An expert not only is someone who knows information, but also someone who is able to apply and transfer knowledge. What separates the expert from the merely competent individual is that the expert can also tell you how to fix those faults and get things working once more. Cornford and Athanasou's (1995) characterization of expertise assists with our work in obtaining the most suitable antecedent of expertise, knowledge sharing.

Germain and Ruiz (2009) defines an “expert” as someone who manifests the following qualities with respect to their work role: (i) specific education, training and knowledge, (ii) ability to assess importance in work-related situations, (iii) capacity to improve themselves, (iv) intuition (v) self-assurance and (vi) confidence in their knowledge.

The aforementioned review of literature on expertise helps this research in formulating an appropriate definition of expertise for the study, identify broad characterization of expertise and observe possible antecedents that must be used in IS nomological testing (chapter 4).

In fact, there is disagreement about the existence of a single definition. Hoffman et al. (1995) suggest that there are almost as many definitions of “experts” as there are researchers who study them. Some of the conceptual research studies in the USA have identified various common themes or dimensions associated with expertise, namely knowledge, experience in the field, and problem-solving skills (Swanson and Holton 2001), as well as self-enhancement characteristics such as self-assurance, intuition, and capacity to improve themselves (Germain 2005; 2006). Although there is no consensus among IS researchers, expertise is commonly defined as a combination of knowledge, experience and problem-solving skills in a particular domain.

The problem of a definition is further complicated by the different qualifications in use for someone who can exhibit expert behaviour or be considered an “expert” in a discipline. Some examples are: a person of genius, one who is talented, gifted, competent, prodigious, capable, excellent and proficient, to mention but a few. The divergent meanings attached to the concept of expertise create great confusion, mainly owing to the domain-specific character of expert behaviour (see Logan 1985; Curtis 1986; McLagan 1997) . Van der Heijde and Van der Heijden (2006), in their article on the conceptualization and measurement of employability, argue that occupational expertise is a prerequisite for positive career outcomes (see Onstenk and Kessels 1999; Boudreau, Boswell et al. 2001). It is also seen as a significant human capital factor for the vitality of organizations. Furthermore, due to the intensification of knowledge, its importance is only growing (Schein 1996; Enders 2002; Van der Heijden 2005). Most of the literature on competence and expertise in The Netherlands can be found in research journals such as *Opleiding & Ontwikkeling*, *in Develop*, or in *Leren in organisaties*, all of which are published in Dutch.

In general, academic view of expertise is influenced by the following literature: Creativity and the Corporate Curriculum (Garvey and Williamson 2002), government policy documents on competences, psychology journals such as the Human Relations Journal, the Atherton pyramid of expertise (Atherton 2003), the Journal for Managerial and Organizational Learning, and papers on activity theory written by Yrjö Engeström ((Engeström, Virkkunen et al. 1996).

Ernst (1994) has summarized the different theories of expertise on the basis of the study of the professional processes that lie behind the theories and models of development. Accordingly, expertise can be defined through models of progression from novice to expert, through processes of decision making involving memory and analytical skills, through a correspondence between cognitive processes and the characteristics of the task, or through processes of developing professional creativity and intuitive capacity in problematic situations. Although one definition of expertise cannot accurately represent scholars' views, expertise could be summed up as a process through which skills are acquired of the domain, decision making, willingness to adapt, analytical, and for problem solving.

Years of Experience

'Years of experience' is one of the most commonly researched constructs in association with the level of expertise. Social Science research on expert performance and expertise (Chi, Glaser et al. 1988; Ericsson and Smith 1991) has shown that important characteristics of experts' superior performance are acquired through experience arguing that exceptional performance is an outcome of the environmental circumstances, such as the duration and structure of activities. Eriksson et al. (1993) hypothesized that the individuals' performances are a monotonic function of the deliberate practice. They argued that the accumulated amount of deliberate practice and the level of performance an individual achieves at a given age is a function of the starting age for practice and the weekly amount of practice.

The view that merely engaging in a sufficient amount of practice, regardless of the structure of that practice, leads to maximal performance, has a long and contested history and is demonstrated in a series of classic studies of Morse code operators. Bryan et al. (1897) and Bryan et al. (1899) identified plateaus in skill acquisition, when for long periods subjects seemed unable to attain further improvements. However, they observed, with extended efforts, operators could restructure their skill to overcome plateaus. Keller (1958) later

showed that these plateaus in Morse code reception were not an inevitable characteristic of skill acquisition, but could be avoided by different and better training methods.

Though it is tautological that 'years of experience' is related to and at times influences the degree of proficiency, such a proficiency-classification that is purely based on the years of experience, for contemporary IS may lead to inconsistent interpretations. Such a simple classification based solely on the number of years would be unreasonable, especially given that a contemporary IS includes many user cohorts ranging from senior managers to data-entry operators - each cohort with a diverse set of skills and capabilities. In parallel disciplines, it has been established that it takes ten-years to become an expert from the time at which practice was initiated (Simon and Chase 1973). Simon and Chase's (1973) "10-year rule" is supported by data from a wide range of domains: music (Sosniak 1985), mathematics (Gustin 1985), tennis (Monsaas 1985), and swimming (Kalinowski 1985). Given that Simon and Chase's 10-year rule has been generalized in a range of disciplines, it is intriguing to evaluate whether the same findings can be generalized in Information System discipline as well.

Knowledge (Cognitive Competence) contributes to expertise

Germain and Ruiz (2009) describe knowledge as an integral aspect of ones' expertise. In the knowledge management stream of literature in IS discipline too, there is strong recommendations for end-user knowledge for system success (Davenport 1996; Davenport 1998; Davenport 1998; Gable, Scott et al. 1998; Bingi, Sharma et al. 1999; Sumner 1999). Research suggest that managing a contemporary Information System as a high knowledge intensive task that necessarily draws upon the experience of a wide range of people with diverse skills and knowledge capabilities (Gable and Klaus 2000; Soh, Sia et al. 2000). Davenport (1998) identifies three types of knowledge that are necessary for managing contemporary Information System lifecycle: (1) software-specific knowledge, (2) business process knowledge and (3) organization-specific knowledge. The three types of knowledge project the complete breadth of knowledge capabilities required for an end-user in an IS and provide the foundation for defining the characteristics of an expert in IS.

Software knowledge refers to knowledge about the product, which includes the knowledge on how to use it. It represents the selection and use of technical knowledge to analyse (e.g., capture requirements), design (e. g., decide on the design pattern and identify best practices), implement (e. g., programme) and maintain (e. g., troubleshoot) the ES

software. It reflects the need for knowledge specific to a particular ES solution. The ES is usually a comprehensive package such as a Systems Application and Products (SAP) solution. Understanding the ES package requires a product-specific knowledge.

Business process knowledge refers to the in-depth understanding of business processes that the employee engages with. It covers the business issues before the actual implementation of the ES, such as issues related to functional knowledge (e. g., purchasing and accounting), educational knowledge (e. g., training) and knowledge about enterprise culture (e. g., computer literature). Davenport (1998) asserts that business process knowledge of an employee should reflect not just the functional area that s/he is involved in, but the entire business process that one is engaged in.

Organisational knowledge includes communication policies, business process management, and organisational procedures and structures. Knowledge of the organisation is important in creating and identifying the user profiles, staff roles and their employment cohorts. Precisely understanding the end user characteristics is a critical success factor for an ES project. This is because the ES software is selected, implemented, used and changed in a specific company with individual characteristics and an individual organisational population. This type of knowledge is also related to specific business and technical knowledge.

Moreover, similar to propositions by Kaplan and Norton (1996), and in light of Davenport's (1998) arguments on types of knowledge, employees' organizational knowledge too is vital in defining ones' expertise. Organizations of the 'knowledge-era' focus on increasing effectiveness through establishing strong foundations in knowledge, which includes not only software knowledge but employees' knowledge of business processes and work practices. Akin to Xu et al., (2003), this study argues that most (if not all) business processes are situational in nature, where the software is adapted to meet needs of specific business circumstances. In light of the aforementioned, it is argued that the two knowledge types of an IS employee are largely responsible for the degree of proficiency.

Moreover, in general (and regardless of the study context), 'training' has been identified as a critical aspect that contributes to employees' knowledge. Such formal training programs ensure wider distribution of highly context-specific knowledge that can be particularly useful throughout the phases of an IS lifecycle (Pan and Chen 2005). In the interest of understanding the contribution of formal training on software and business knowledge, this study includes 'formal training' as an antecedent of overall knowledge.

The levels of expertise (figure 6), also known as the ‘degree of proficiency’, is generally associated with skills, expertise and knowledge, which extends over a continuum, from *novice* → *intermediate* → *expert*, where an ‘expert’ holds the highest degree of proficiency (Eriksson and Charness 1994). Expertise, in general, is defined as superior performance in terms of success, swiftness, and/or accuracy. In between two extremes of experts and novices are the intermediates.

Novice: a novice has only factual and free-context rules acquired from training and is typically at the early stage of the career (Dreyfus 1992).

Expert: an expert has recognized knowledge and expertise who can comment authoritatively on an issue and often is asked to give an opinion with regard to the specific facts (Bainbridge 1989; Olsen 1989) Experts seem to have prolonged or intense experience through practice and education on their field of expertise.

Intermediate: between two the extremes of a novice and an expert, is an intermediate.

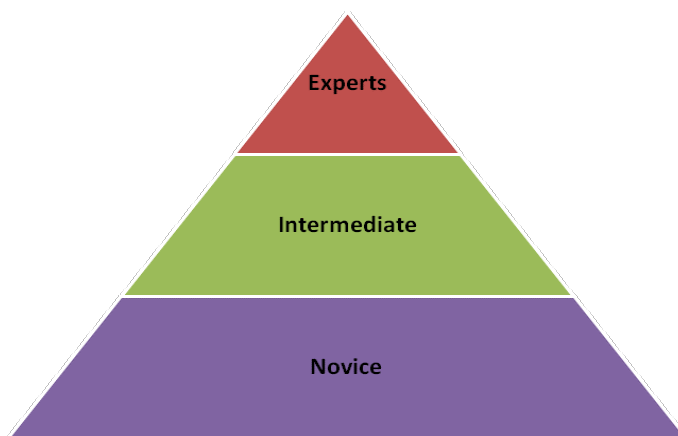


Figure 6: Levels of Expertise

Current literature seldom provides a clear rationale for segregating respondents according to their expertise.

User competence and Self efficacy

In Information Systems, research on user competence (e.g. Munro, Huff et al. 1997) and computer self efficacy (Bandura 1977a; Bandura 1977b; Bandura 1997; Bandura 2007), provide a wealth of knowledge on how to conceptualize and measure ‘staff computing

ability' (Munro, Huff et al. 1997). Yet, as Marakas et al., (2007) observed, "[these disciplines] have focused heavily on models in very distinct domains", focusing predominantly on simple information systems (i.e. spreadsheets, word processing) and lacking emphasis on contemporary IS. At a time where organizations are in a transition from in-house, custom-made, stand-alone applications to integrated, complex, customizable software packages (Gable, Sedera et al. 2008), this study argues for the importance of revisiting Contemporary Information Systems User Expertise. Given the unwieldy expression 'Contemporary Information Systems User Expert/ies', further reference to this concept is simply 'Expert/ies', where the contemporary nature of the system and user expertise is implied. User expertise in contemporary IS could make the difference between performing the bare minimum to optimal, value-adding usage (Burton-Jones and Straub 2006; Burton-Jones and Gallivan 2007), where higher level of expertise contributing to better system usage.

Research on computer self efficacy and user competence provides a useful theoretical background to this study. For decades organisations have tried to identify the important elements that affect users' competence. The most likely factors would be organisational, task, individual and technological. Better understanding of the end user computing process will enable managers to develop effective strategies for improving individual skill and usage levels.

User Competence means, how users differ in their capability, and how these differences relate to other individual characteristics. Munro et al. (1997) summed up the User Competence construct as multi-faceted. They proposed that the construct "composed of an individual's breadth and depth of knowledge of end user technologies, and his or her ability to creatively apply these technologies". Their research led them to conceptualise User Competence as consisting of three independent dimensions: 1) breadth- this dimension refers to the extent, or variety, of different end user tools, skills, and knowledge that an individual possesses and can bring to impact on his or her work 2) depth- this second dimension refers to an individual's End User Computing (EUC) capability. This dimension represents the completeness of the user's current knowledge of a particular EUC sub-domain (for example, using a spreadsheet). Individuals will differ in their knowledge based on the extent of their use of its capabilities, and 3) finesse- this dimension is defined as "the ability to creatively apply EUC." Some end users would be known to be power users with respect to certain EUC technologies. The power users had more than the average level knowledge of the commands

and capabilities of certain application packages or technologies. They then apply this knowledge to exercise innovativeness and creativity in the practical use of the technology. Munro et al. (1997) also looked at the correlation between User Competence and self-efficacy. They concluded that end user self-efficacy is significantly related to User Competence and they further mention that higher self-efficacy leads to greater competence. They also observed that self-efficacy was more closely related to an individual's depth of knowledge than to the breadth of his or her experience.

In a study conducted by Marcolin et al. (2000) User Competence (UC) has been defined “as the user's potential to apply technology to its fullest possible extent so as to maximize performance of specific job tasks”. Marcolin et al.'s.(2000) Conceptualization of an individual's competence originates from Kraiger et al.'s. (1993) identification of three different outcomes associated with learning: 1) cognitive outcomes: this refers to the knowledge users have about what a technology is and how to use it. Others (Anderson 1980; Kraiger, Ford et al. 1993) have referred to this as declarative knowledge, 2) skill-based outcomes: in this phase learners develop their ability to generalize procedures to novel tasks and they can improve their performance by moving beyond the initial steps learned into more fluid and efficient processes. In other words the individual displays the ability to adopt/adapt to a new environment. For example, “those learning word processing might proceed from the knowledge that bold formatting to text can be accomplished by highlighting the text and then selecting “bold” from a menu or toolbar, and that underline is accomplished in the same way” (Marcolin, Compeau et al. 2000), and 3) affective outcomes: this outcome includes attitude and motivation. Kraiger et al. (1993) defines this outcome as if a learner's “values have undergone some change... then learning has occurred”. In other words, it refers to the individual being proactive in learning beyond what has been provided. These three outcomes represent different conceptualizations of an individual's competence and can be used to understand differences in the effectiveness with which people use technology.

Self-efficacy (Bandura 1986) is an individual's perception of his or her ability to successfully execute some specific task. In IS research self-efficacy has been considered to be either an antecedent to or an outcome of competence (Davis, Bagozzi et al. 1989; Marcolin, Huff et al. 1992; Compeau and Higgins 1995 b; Compeau and Higgins 1995a) . “There is no all-purpose measure of perceived self-efficacy. The “one-measure-fits-all” approach usually has limited explanatory and predictive value because most of the items in an all-purpose

measure may have little or no relevance to the selected domain of functioning... scales of perceived self-efficacy must be tailored to the particular domains of functioning that are the object of interest” (Bandura 2001 p.1).

Marakas et al. (2007) proposes a computer self-efficacy construct (CSE) based on Bandura’s self-efficacy theory. Their study provides a detailed comparison amongst and between various available measures of computer self-efficacy (CSE). Their intention being, to isolate the CSE construct from other related constructs and capture, variance in performance attributed to changes in CSE level. Originally CSE was conceptualized at the task-specific level however, recent studies have established the construct at both the application-specific level (word processing, spreadsheet, etc.) and at a more general computing level (Bandura 1977b; Marakas, Yi et al. 1998).

Enterprise Systems

This study tests the Expertise Model (Chapter 4) in the context of Enterprise Systems. Data was gathered from three organisations using Enterprise Systems. This is discussed in detail in Chapter 4. In order to understand the research context it is important to understand the background and characteristics of an Enterprise System.

An Enterprise system includes a set of software modules linked to a common database. These modules can handle basic organisational functions such as manufacturing, finance, resources, sales and management (Xuea, Liang et al. 2005). Enterprise systems typically include the following characteristics, 1) an integrated system that operates in real time (or next to real time), without relying on periodic updates, 2) a common database, which supports all applications, 3) a consistent look and feel throughout each module, and 4) installation of the system without elaborate application/data integration by the Information Technology (IT) department.

The nature of ES is complex because it involves multiple stakeholders, including ES vendors, consultants and the client organisations (Sedera and Gable 2010). The multiple stakeholders, within and outside the organisation, possess diverse portfolios to develop a timely and workable solution (Tiwana 2003). Individuals in organisations bring together a wide variety of know-how, skills and abilities relation to ES. Thus, they would also possess various levels of expertise.

IS–Impact Measurement Model

The IS-Impact Measurement model is used to further evidence the difference between a novice, intermediate and expert. These three groups evaluate an Enterprise system using the four dimensions of the IS-Impact Measurement model.

The four quadrants of the IS-impact measurement model (Gable, Sedera et al. 2008) are derived from the most widely cited IS success model by DeLone and McLean (1992). The DeLone and McLean model consists of six constructs: quality measures of system and information, performance-related outcomes of individual and organisational impacts, and attitudinal outcomes of use and satisfaction. For a range of reasons, use and satisfaction constructs are not included in the Gable et al. (2008) model. They argue that the use construct is considered to be an antecedent to IS impact. They also believe that the satisfaction construct is an immediate consequence of IS impact. Furthermore, early studies of IS success, such as the work of Rai et al. (2002), report that the satisfaction construct is readily measured indirectly through other constructs such as information quality and system quality.

In addition, the existing models developed for measuring IS success in a traditional IS context do not properly measure the ES success (Gable, Chan et al. 2003) due to the complex nature of an ES (Ifinedo 2007) and its specific characteristics (Zach 2010). Taking into account the above factors, Gable et al. (2008) proposed the IS-impact measurement model as a set of overarching dimensions to evaluate IS success, as well as to address the issue of inappropriate measurement of ES success. The proposed model is the first attempt that successfully develops a specific success measurement model for the ES context (Gable, Sedera et al. 2008; Zach 2010). Furthermore, the model is found to be the most comprehensive tool for IS measurement that captures the complex nature of the ES (Petter, DeLone et al. 2008). The IS-impact model adopts four constructs from DeLone and McLean (1992) and employs them in two categories: impacts (individual impact and organisational impact) and quality (system quality and information quality). The four dimensions avoid overlapping between constructs and measures, and have strong construct validity (Zach 2010). The model of IS-impact is depicted in Figure 7.



Figure 7: IS-Impact Measurement Model

Gable et al. (2008) propose individual impact (II) as individual capabilities and effectiveness that are influenced by IS application. This construct accommodates diverse individual impact measurements of system usage to all employment cohorts, applications, capabilities and functionalities of the ES. Organisational impact (OI) refers to benefits received by the IS application at the organisational level, focussing on variables related to organisational impacts include items of cost reduction, productivity improvements and business process change. The system quality (SQ) construct represents the quality of the IS itself, and is designed to capture how the system performs from technical and design perspectives. This construct is measured by items such as ease of use, ease of learning and alignment with user requirements. In contrast with the system quality, the construct of information quality (IQ) is concerned with the system's output quality and refers to the information produced in reports and on-screen (DeLone and McLean 1992; Gable, Sedera et al. 2008; Gorla, Somers et al. 2010) . Table 1 lists the measures offered by the IS-impact model for the validity of ES success. There are 27 measures which appropriately assess the ES success and avoid overlapping measures as in the IS success model by DeLone and McLean (1992) as shown in the table below.

| Constructs | Measures |
|-----------------------|---|
| Individual Impact | <ul style="list-style-type: none"> • Learning • Awareness/recall • Decision effectiveness • Individual productivity |
| Organisational Impact | <ul style="list-style-type: none"> • Organisational cost |

| | |
|---------------------|---|
| | <ul style="list-style-type: none"> • Staff requirements • Cost reduction • Overall productivity • Improved outcomes/outputs • Increased capacity • E-government • Business process change |
| System Quality | <ul style="list-style-type: none"> • Ease of use • Ease of learning • User requirements • System features • System accuracy • Flexibility • Sophistication • Integration • Customisation |
| Information Quality | <ul style="list-style-type: none"> • Content accuracy • Availability • Usability • Understandability • Format • Conciseness |

Table 1: IS-impact measures

CHAPTER SUMMARY

This literature review began with an overview of the research and literature review strategy. It was then followed by a discussion on prior studies conducted in the area of Expertise. The literature review then introduced the topics of User Competence and Self-Efficacy. The next section introduces some common definitions of Expert and Expertise as reviewed in literature. The three groups: Novice, Intermediate and Expert are introduced as, this study empirically tests the difference in scores that a novice, intermediate and Expert gives in relation to evaluating a system. This study then discusses the relation between years of experience and expertise. The next section introduces the construct Cognitive Competence/Knowledge and this study discusses how this contributes to an individual's

expertise. It is important to understand the characteristics of an Enterprise System since this study tests the levels of expertise in relation to evaluating an enterprise system. The chapter finally introduces the IS-Impact measurement Model as this model is being employed to see the difference in scores that the novice, intermediate and expert give to the four dimensions of this model, in evaluating a system. The next chapter discusses the research model and the methodology.

CHAPTER 3: RESEARCH MODEL DEVELOPMENT

This chapter begins with a discussion of the conceptual model that was introduced in chapter 1. The key constructs of the conceptual model and the arguments presented herein lead to the a-priori model. The constructs of the a-priori research model that were derived through a detailed review of related literature, are summarized herein.

In Chapter 2 literature related to the four constructs (Cognitive Competence, Skill-Based, Affective and Years of Experience) have been reviewed and discussed in detail. In this chapter the research model and its constructs, sub-constructs and the items relating to each sub-construct is explained. Next, the data collection methodology is presented here. This study employs empirical data gathered through a survey. The chapter discusses the appropriateness of the survey method for the study purposes. Moreover, this chapter will discuss the data collection procedures. This chapter then concludes with a summary.

DEVELOPING A CONCEPTUAL FRAMEWORK FOR IS EXPERTISE

Research on computer self-efficacy and user competence provides a useful theoretical background to this study. Bandura (1986) defined self-efficacy as “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is not concerned with the skills one has but with judgments of what one can do with whatever skills one possesses” (p. 391). Therefore, the concept of self-efficacy was context specific, or the valuing of self through specifically defined situations. The definition of self-efficacy provided by Bandura (1986) highlighted the importance of distinguishing between component skills and the ability to perform actions. Further studies by Bandura discussed the psychological construct of self-efficacy as a concept that referred “to beliefs in one’s capabilities to mobilize the motivation, cognitive resources and courses of action needed to meet situational demands” (Wood and Bandura 1989, p.506). In general, the construct reflects ones perceived skills, ability, including motivational and the ability to adapt to work environments as well (Wood and Bandura 1989; Gist and Mitchell 1992). Originally conceptualized at the task-specific level, computer self-efficacy can be hypothesized to be far more complex than previously suggested (cf. Compeau and Higgins 1995a). Self-efficacy has been studied at both the application-specific level (word processing, spreadsheet, etc) and at a more general computing level (Bandura 1986; Marakas, Yi et al. 1998).

As researchers note that, becoming an expert in the 21st century professional workplace involves a complex array of knowledge and skills as well as processes (Feltovich, Spiro et al. 1997; Yates and Tschirhart 2006). Past research contend that, this new workplace emphasises on such things as the need for dealing with deep understanding, the ubiquity of change and novelty, the simultaneous occurrence of processes, the interactiveness and interdependence of processes and people, the demand for customisation/particularisation in both products and procedures, non-hierarchical-linear management structures and the like (Davenport 1998). The intension herein is to employ Bandura’s and related work by others as the foundation

and then to develop constructs and measures related to contemporary Information Systems expertise considering both cognitive skills as well as their ability to adapt and adopt to new situations.

Observing past research in Information Systems (e.g. Munro, Huff et al. 1997; Bandura 2007; Marakas, Johnson et al. 2007), Psychology (e.g. Pamela, Michael et al. 2001; Page and Uncles 2004), and Sociology (e.g. Eriksson, Krampe et al. 1993; Eriksson and Charness 1994), this study identifies three salient considerations for developing constructs and measures for contemporary IS user expertise: (i) type of system, (ii) measurement constructs/ domain, and (iii) evaluation method. The approach in this study is similar to the one reported in Marcolin et al. (2000), wherein their discussion of User Competence of Spreadsheets and Word Processing, included: (1) Measurement Method – self-report, paper-and-pencil test, Hands-on, observer assessment, (2) Knowledge Domain Areas – Software and Hardware Knowledge, and (3) Conceptualization of Competence – Cognitive, Skill-based and Affective. This study agrees that Measurement method, Conceptualization and Knowledge Domain areas are still important in understanding ones expertise; the essential difference being the inclusion of the type of the system.

This study argues that one could conceive expertise using any combination of these three considerations. In figure 8, cells marked with ‘A’ denote where past studies of computer self-efficacy and user competence concentrate on, which cells marked as ‘B’ provide the scope for this research. The scope (i.e. cells) must be selected with care, understanding the intent of the study context, acknowledging that some combinations of cells are less realistic and less informative. This study recommends that the primary consideration herein should be the ‘type of the system’. Thus, as a rule-of-thumb, this study suggests that the selection of cells be based, first on the system, next the on the domains, and finally selecting the measurement approach. One should then commence developing measures appropriate to the selected context (Burton-Jones and Straub 2006).

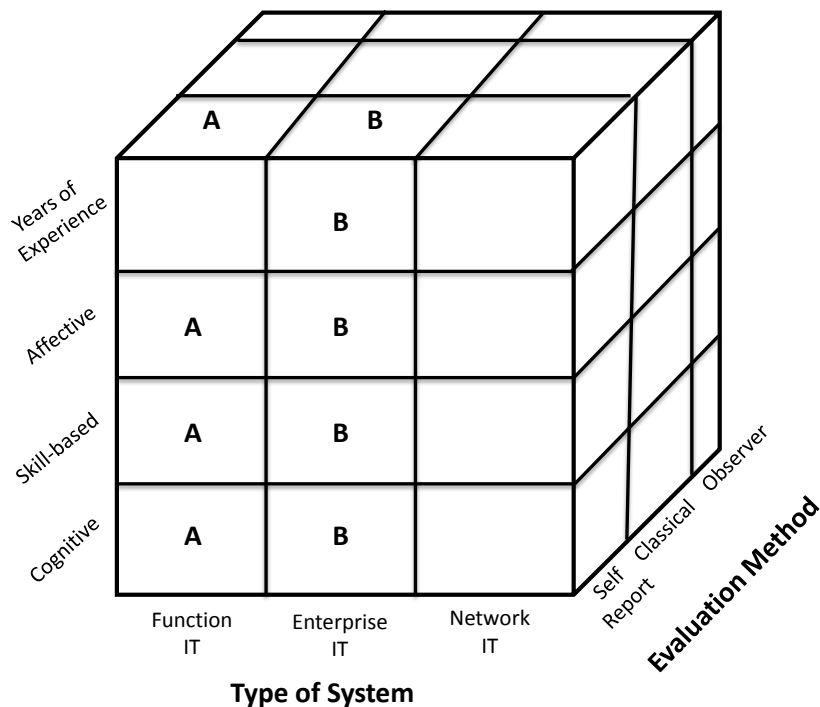


Figure 8: Expertise Framework

Type of the System

In order to understand how expertise in one type of a system could be different to another, this study uses the simple system classification provided by McAfee (2006), where systems were grouped into: Function IT, Network IT and Enterprise IT. This thesis will not discuss Network IT herein. Network IT facilitates interactions without specifying their parameters. Examples of Network IT include: Emails, instant messaging, wikis, blogs and mash-ups. Appendix A presents a summary of differences between these three systems. According to McAfee (2006), Function IT assists only with the execution of discrete tasks. Examples of Function IT include word Processing, spreadsheets, and computer aided design statistical software. McAfee also outlines that Function IT can be adopted without complements, and argue that most contemporary Function IT operates within the same operational framework (e.g. almost identical menu paths between Microsoft Word and Microsoft Excel). Complements are defined by McAfee (2006, p. 142) as "organizational innovations, or changes in the way companies get work done". Examples of complements that allow working performing technologies, according to McAfee

((2006, p. 143) are “better-skilled workers”, “higher levels of teamwork”, “redesigned processes”, and “new decision rights”.

Moreover, users of Function IT would attain a reasonable expertise with the basic (and essential) functionality of Function IT and even a novice user could easily adapt to changes of the Function IT without much exertion. Given the nature of Function IT, it is essential that an employee is required to use more than one application for their daily work, changing between one Function IT to another. As an example, most Function IT users are likely to use a spreadsheet, presentation and word processing applications in a single day. Thus, required skills, knowledge and motivation to switch between applications (commonly known as the ‘switching effort’) are minimal. Yet, most computer self-efficacy and user competence studies report the ability to switch between Function IT applications as the ‘competence’ (e.g. Marcolin, Compeau et al. 2000). This study differs and argues that a contemporary IS user, given their familiarity with Function IT applications, can easily adapt from one Function IT application to another.

On the other hand, Enterprise IT is new to most IS users and they specify business processes and impose complements throughout the organization (McAfee 2006). The processes and the task sequences of the processes, data format and, in most cases use of an Enterprise System are mandated by the organization. Furthermore, Enterprise IT users – unlike Function IT – are rarely required to use more than one Enterprise System. This means that the ability of a user to adopt *new* technological applications, as employed in computer efficacy studies is less relevant to the context of Enterprise IT. Instead, the focus must be on how well a user evolves from being a novice user, presumably at the ‘go-live’ time, then developing their expertise over the lifecycle.

Furthermore, given the process nature of Enterprise Systems, Enterprise IT users must focus on the business processes expertise, not task expertise (e.g. Davenport 1998; Gable, Sedera et al. 2008).

Measurement Construct / Domain

Studies of learning and training theories (Anderson 1980; Kraiger, Ford et al. 1993) identify three different outcomes associated with learning: cognitive, skill-based and affective. Cognitive outcomes – commonly referred to as declarative knowledge – refer to the knowledge users have of the technology. Marakas et al (2007) suggest that the cognitive knowledge measures must be derived through a full understanding of the context of the study, rather than simply adopting from past studies. Skill-based outcomes capture the user's ability to adapt and adopt into novel situations. Herein, most past computer self-efficacy and user competence studies measure user's ability to generalize procedures at simple tasks. Marcolin et al (2000, p. 39) note "those learning word processing might proceed from the knowledge that applying bold formatting to text can be accomplished by highlighting the text and then, selecting "bold" from a menu or toolbar, and that applying underline is accomplished in the same way, to the recognition that most character formatting is applied in this fashion". This study argues that 'moving beyond the knowledge' in a contemporary corporate-wide system should entail a more fluid and a holistic approach, where the user shows the 'ability' to learn continuously. Contemporary thinking is that, 'proactive self learners' excel in dynamic contexts (Germain 2009), like in the case of Enterprise Systems.

Affective outcomes relate to attitude and motivation (including aspects of self-efficacy). As per Marcolin et al. (2000), this study too conceives the Affective construct as a higher level term which encompasses the motivational components. This notion parallels with the study of Germain (2009) who included 'willingness to adopt and adapt' as a construct of expertise. In addition, 'Years of Experience' is also considered as having a positive influence on expertise. For example, Simon and Chase (1973) initiated a series of observations in disciplines ranging from tennis (Monsaas 1985), mathematics and (Gustin 1985), music (Sosniak 1985) observing that it takes approximately 10 years for one to become an expert from the time at which practice was initiated. Despite its wide adoption, Simon and Chase's 10-year expertise-based-on-experience rule has never been empirically tested in IS research.

Evaluation Method

Three types of measurement methods have been employed in past expertise / competence; (i) self-reported measures (e.g. Bilili, Raymond et al. 1998), (ii) classical method (e.g. Eriksson and Charness 1994; Compeau and Higgins 1995a), and (iii) observer assessment (e.g. Rockart and Flannery 1983). Self-reported measures are provided by individuals assessing their own abilities, while in the classical approach¹ expertise is measured by the investigator based on how well one responds to a set of questions. In general, the classical approach is appropriate when expertise can be measured using a set of finite questions that are not subjected to external / contextual factors (e.g. in mathematics). The observer assessment method involves rating of skills of an individual by an independent observer, in most cases by the colleagues. Studies have shown that all three methods provide a reasonable assessment of an individual's skills, knowledge and in general, expertise (Germain and Ruiz 2009). In particular, Germain and Ruiz (2009) observed a strong correlation between expertises measured using the self-assessment method and the classical approach. The method of measurement must be selected with care, paying close attention to its suitability to the phenomena of measurement. For example, Mann (2010) and Moskal (2010) note lesser-skilled are more likely to exaggerate their skills. Germain (2009) and Germain and Ruiz (2009) note that the classical method cannot be employed in studies where there is no finite answer, and the answer is moderated by the context (Germain 2009; Germain and Ruiz 2009).

The conceptual model in figure 9 is derived through the cells marked with 'B' in figure 8, which illustrate the scope of this research. The choice of considerations (marked as 'B') was guided by theoretical and pragmatic considerations. In this study the system of interest is Enterprise Systems, domains including cognitive, motivational, and skill-based outcomes, using the self-evaluation measurement approach. The decision with respect to choosing the self-reported measures follows closely the conceptualizations of the type of the system and measures of expertise derived through a five-phased study design (figure 3 and related discussion).

¹ The classical approach can be further divided into hands-on and paper-and-pencil tests.

Moreover, the classical measurement approach (using ‘paper-and-pencil’ and ‘hands-on’ testing) was deemed inappropriate for measuring expertise in this context, where knowledge is non-declarative and influenced by the context (e.g. Anderson 1980).

DERIVING THE A-PRIORI MODEL

Results of the mapping and content validation stages, of the research design helped to form the expertise a-priori model constructs and measures. Specifying a parsimonious a-priori model for expertise involved: (i) elimination and consolidation of domains; (ii) introduction of new domains or measures; and (iii) revisiting the relevance of the domains identified in literature review. Thus, in the interest of parsimony, and consistent with formative index development procedures (Jarvis, MacKenzie et al. 2003; Petter, Straub et al. 2007; Cenfetelli and Bassellier 2009; Diamantopoulos 2009), 4 constructs were included as measures in the expertise a-priori model. Thus, it was deemed appropriate to identify a single measure that can be used for an item for each measure to be included in the a-priori model.

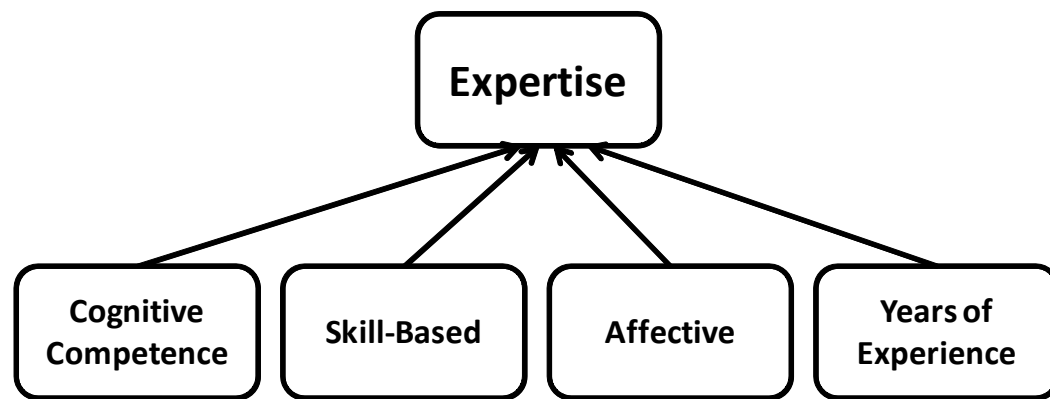


Figure 9: The a-priori model without measures

Conceptualization of the expertise construct as a second-order formative construct is an important distinction of the current study conceptualization.

First, work by Petter et al. (2007) has cast doubt on the validity of many mainstream constructs employed in IS research over the past 3 decades; critiquing the almost universal conceptualization and validation of these constructs as reflective when in many studies the measures appear to have been implicitly operationalized as

formative. Gable and Sedera (2009) demonstrated through an archival analysis of studies between 1985-2007 that most past Information Systems studies conceived, operationalized and sought responses from participants as formative constructs, yet employed reflective validation methods. This also applies to the research domains of computer self-efficacy and end-user computer competence.

Second, in conceptualizing expertise, we conceive each construct to be *formative*, with a set of minimum number of measures for each construct to maintain parsimony. Akin to its original intent, the formative measurement provides “specific and actionable attributes” of a concept (Mathieson et al. 2001), which is particularly interesting from a practical viewpoint. In formative measurement, the weight of a single indicator can be used to draw practical implications on the importance of specific details and therefore guide practical enforcement on these system characteristics (e.g., ‘the overall knowledge is high’ (reflective) vs. ‘the knowledge of the business processes is high’ (formative)). Another possibility of modeling ‘actionable attributes’ would have been the use of multi-dimensional constructs, where the first order constructs (the dimensions) can be measured reflectively (see also, Wixom and Todd 2005). However, taking the IT decision makers’ time constraints into account, this approach would have been rather impracticable, as it would raise the numbers of questions used by the number of three (assuming three indicators per first-order construct).

Next, for the four constructs of Figure 9, appropriate measures were identified through past literature. In addition, as identified in the literature review, the researcher decided to include ‘knowledge sharing’ as an antecedent of expertise.

Scale Construction

The questions to measure Cognitive Competence, this study derives questions based on the Munro et al. (1997), End User Sophistication questionnaire. Munro et al. (1997), in their study of User Competence employed, a scale to gauge the depth of cognitive competence. Those measures yielded a self-reported knowledge score that was based on an assessment of how well (on a scale from 1 to 7) respondents knew the particular package with which the questionnaire was based on. Combining the

scale of Munro et al. (1997) with the core knowledge types for Enterprise Systems as per past Enterprise Systems knowledge management literature (e.g. Davenport 1998; Sedera and Gable 2010), the following six questions are employed to gauge cognitive competence (table 2).

| COGNITIVE COMPETENCE [KNOWLEDGE REQUIREMENTS] |
|---|
| C1: I fully understand the core knowledge necessary for [name of the business process]. |
| C2: My knowledge of SAP is more than enough to perform my day-to-day functioning of the [name of the business process]. |
| C3: I rarely contact SAP helpdesk for software related problems in relation to the [name of the business process]. |
| C4: I rarely make mistakes when completing my [name of the business process] using SAP. |
| C5: I have an in-depth knowledge of the functions of the [name of the business process] that I must do on a day-to-day basis. |
| C6: I have a good knowledge of the organizational goals, procedures and guidelines. |

Table 2: Cognitive Competence Measures

Measures for ‘Skill-based’ (4 measures) and ‘Affective’ (5 measures) were adapted from Germain and Tejeda (2009).

| SKILL-BASED [PROACTIVE SELF LEARNING] |
|--|
| S1: I regularly refer to corporate database (e.g. intranet) for updates and gain new knowledge of my [name of the business process]. |
| S2: I regularly observe changes to company policies and guidelines through information repositories relevant to my [name of the business process]. |
| S3: I try to find better ways of doing my [name of the business process] in the SAP system. |
| S4: I am eager to learn improvements in the SAP system related to my [name of the business process]. |

Table 3: Skill-Based Measures

| AFFECTIVE [WILLINGNESS TO ADAPT] |
|--|
| A1: I can easily adapt to any changes to the SAP system required for the [name of the business process]. |
| A2: I can easily adapt to changes in my [name of the business process]. |
| A3: I can easily adapt to changes in my department, related to my [name of the business process]. |
| A4: I can easily absorb any changes in my organizational structure, related to [name of the business process]. |
| A5: I am ready to accept new roles and responsibilities related to my [name of the business process] when necessary. |

Table 4: Affective Measures

In total, the current study employs 15 measures comprising of cognitive competence, skill based and affective constructs. Within each construct, there is a strong association with the broader topics e.g. business processes, software, organization, application of software to business processes.

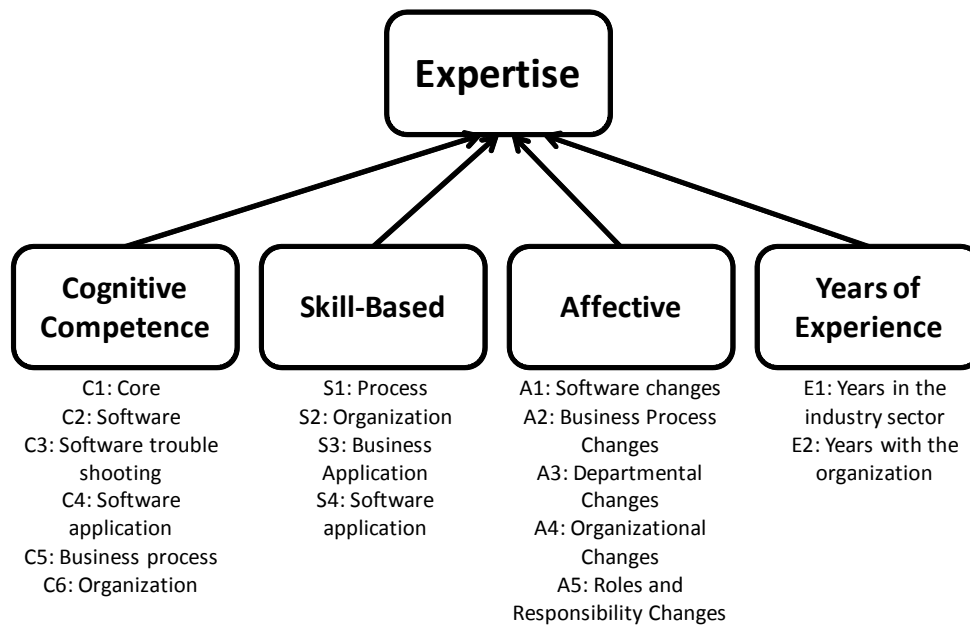


Figure 10: The a-priori model

The a-priori model does not purport (is not concerned with) any causality among the constructs; rather the constructs are posited to be formative constructs of the multidimensional concept – Expertise. As per the guidelines for identifying formative variables, constructs and measures of expertise; (i) need not co-vary, (ii) are not interchangeable, (iii) cause the core-construct as opposed to being caused by it, and (iv) may have different antecedents and consequences in potentially quite different nomological nets (Jarvis, MacKenzie et al. 2003; Petter, Straub et al. 2007; Cenfetelli and Bassellier 2009).

Once the expertise model is specified, this study employs the ‘knowledge sharing’ construct to further validate the expertise construct in its nomological net (as per formative construct validation guidelines). According to Jarvis et al. (2003), these other constructs can be either antecedents or consequences of the phenomena under

investigation². Thus, consistent with Jarvis et al. (2003) and Bagozzi (1994), and with the (third) guideline of Diamantopoulos and Winklhofer (2001) for validating formative constructs in a nomological network, this study next tests the relationship between expertise and ‘knowledge sharing’ as one of its immediate consequences.

The précis below of knowledge sharing is not intended to provide an in-depth overview of knowledge sharing and its associations with expertise, rather to present the argument for this seemingly tautological scenario where experts share knowledge with their peers. Numerous studies note that managing knowledge, where knowledge sharing is an essential part of, is imperative to ES success (e.g. Pan, Newell et al. 2007; Sedera and Gable 2010). Studies of several disciplines; IS (e.g. Bender and Fish 2000; Swap, Leonard et al. 2001), business (e.g. Gregan-Paxton and John 1997), and psychology (e.g. Boose and Bradshaw 1987; Hinds 1999; Bartol, Durham et al. 2001); suggest that experts, are willing, able and motivated to convey their superior knowledge and skills to novices.

| KNOWLEDGE SHARING |
|--|
| <ol style="list-style-type: none"> 1. I regularly share my knowledge of SAP with my colleagues. 2. I often suggest improvements of [name of the business process] to my managers / colleagues. 3. My colleagues come to me for assistance when they are faced with a work related issue. 4. I have colleagues and workmates helping me with using SAP for my [name of the business process] (inversely worded). 5. I regularly contribute to knowledge sharing forums within my organization. |

Table 5: Knowledge Sharing Measures

IS success is employed to apply the expertise classification that this study will derive to understand whether groupings based on different levels of expertise demonstrate significant differences in their success evaluations. These discussions are forthcoming in this study. In attention to reducing Common Method Variance, items for expertise, knowledge sharing and IS success were not grouped under their construct headings.

² Bagozzi, R. (1994). Structural equation models in Marketing Research: Basic Principals. *Principals in Marketing* R. Bagozzi. Oxford, Blackwell: 317-385.

suggests, “After all, the substantive reason behind index construction is likely to be how the index functions as a predictor or predicted variable” (p. 332).

The IS-Impact Measurement Model

Once the measures of expertise are validated and yields classifications based on their expertise, the study explores whether the cohorts of expertise demonstrate significant differences in their evaluation of their ES. The reasons for selecting IS success as the ‘application’ area are several; (i) the natural alliance between success evaluation and expertise, where in practice, ‘expert views’ are frequently sought in system evaluations, (ii) respondents having different views is a key notion purported in IS success studies, yet according to many, a concept that is under investigated (e.g. Cameron and Whetten 1983; Grover, Jeong et al. 1996; Seddon, Staples et al. 1999) and (iii) the popularity of IS success studies (e.g. DeLone and McLean 2003; Sabherwal, Jeyaraj et al. 2006; Gable, Sedera et al. 2008; Petter, DeLone et al. 2008) suggesting that this application is relevant and meaningful to a greater community.

To measure IS success, this study employs 27 measures of the IS success model of Gable, Sedera and Chan (2008) in Appendix D and data was collected using the respondents in the same survey. The Gable et al. (2008) IS Success model too is conceptualized as a formative, multidimensional index comprising of four dimensions – Individual Impact, Organizational Impact, System Quality and Information Quality. The definition of each of the four constructs, as per Gable, Sedera and Chan (2008), is demonstrated in table 6. This multidimensional conception of success has garnered some endorsement in recent literature; in example, Petter et al. (2008) cite Gable et al. (2008) model as one of the most comprehensive, and comprehensively validated IS success measurement models to-date.

Using the 27 measures, this study follows all four (4) dimensions, as shown in Table 6, namely, Organisational Impact (OI), Individual Impact (II), System Quality (SQ), and Information Quality (IQ). This study employs all 27 measures of the IS impact measurement model. The IS Impact measurement model instrument items are listed in Appendix D.

| Dimensions | Definitions |
|-----------------------|---|
| Information Quality | This is to measure the quality of the Enterprise Systems outputs. |
| System Quality | These measures are used to examine the performance of the ES from a technical and design perspective. |
| Individual Impact | These measures are the items that assess the extent to which the ES has influenced the capabilities and effectiveness of key users on behalf of the organisation. |
| Organisational Impact | These measures represent the assessment of the extent to which the ES has promoted improvement in organisational results and capabilities. |

Table 6: Dimensions of the IS-Impact Measurement Model

RESEARCH METHODOLOGY

In this section of the chapter, this study discusses the operationalisation of the research model and the application of the survey method (as shown in Figure 1 in Chapter 1). The data collection objectives are discussed followed by the appropriateness of the survey methodology for this study. The following sections present the design of the survey process in detail and the procedures to operationalise the research model constructs. This chapter then discusses the steps taken to minimise the common method variance (CMV). Lastly, the respondent anonymity and confidentiality are discussed.

Data Collection Objectives

The primary goal of this study is to identify the salient characteristics of Expertise. This study also aims to identify the varying levels of expertise (novice, intermediate and expert) that individuals possess. To achieve this goal, this study aims to develop valid and reliable constructs and measures to measure expertise. This required that a

representative sample of companies and respondents are selected that meet the criteria outlined in chapter 1 (figure 1). Also, the data collection instrument must be designed in a way that allows gathering of perceptual evaluations of their own skills (self-assessment).

Appropriateness of the Survey Methodology

The survey data collection approach was chosen to operationalize the dimensions and measures of the Expertise model. Survey research is widely used in the field of Management Information Systems (MIS) to derive research models and validate survey instruments. Traditionally, survey research is known to have a strong emphasis on aspects where field research is weak. Attewell and Rule (1984) state that survey research can be usefully employed in documenting the norm accurately, identifying extreme outcomes and delineating associations between variables in the sample.

In the context of expertise, it is necessary that this study identifies and validates the contributions of the salient dimensions. Thus, rather than selecting a qualitative method, this research was inclined to selecting a quantitative approach.

Furthermore, the survey methodology allows data to be analysed at aggregate as well as at individual levels. This allows researchers to better explain the validity of the survey instruments as well as to validate characteristics of the research model. Furthermore, survey research facilitates more rigorous hypothesis testing and generalization by giving more cases and more systematic data than, for example, case studies (Ishman 1996). In the context of this study, the survey gathered information from three medium sized organisations, using the same enterprise system (SAP).

Survey research has the potential to add to the inventory of previously well-developed survey research instruments (Ishman 1996). Benbasat et al. (1987) state that such an inventory of instruments allows the Management Information System (MIS) field to be more productive and could excel in research without re-inventing

survey instruments. Straub (1989) states that instrument validation is inadequately addressed in the MIS research. McFarlane and McKenney (1983) state that instrument design is ‘intimately’ connected with concerns of MIS research and argue that research should be carried out in a systematic and programic manner, using advanced scientific methods.

Survey instrument validation helps researchers to provide greater clarity to research findings and in-depth analysis to research questions (Bagozzi 1980). Hunter et al. (1982) state that validated instruments provides greater corporative research in the field of MIS. Validated instruments would allow other researchers to conduct follow-up research, and use of the same survey instrument in heterogeneous environments would help researchers to triangulate findings. As reported in chapters one and three, this study takes a specific focus on deriving the expertise construct in relation to contemporary IS, employing self-evaluation data. Therefore, the derivation of the instrument to gauge Expertise and research model would allow future researchers to use a ‘validated’ instrument to initiate and increase a cumulative tradition of research.

The Survey Design

Figure 11 depicts the main steps of the survey design. This survey design is further expanded from the research design as previously shown in Figure 3 (in Chapter 1). The survey design process includes six steps: 1) design the survey instrument; 2) select the data sample; 3) validate the content of the survey instrument; 4) pilot test the survey instrument; 5) revise the survey instrument; and 6) deploy the survey.

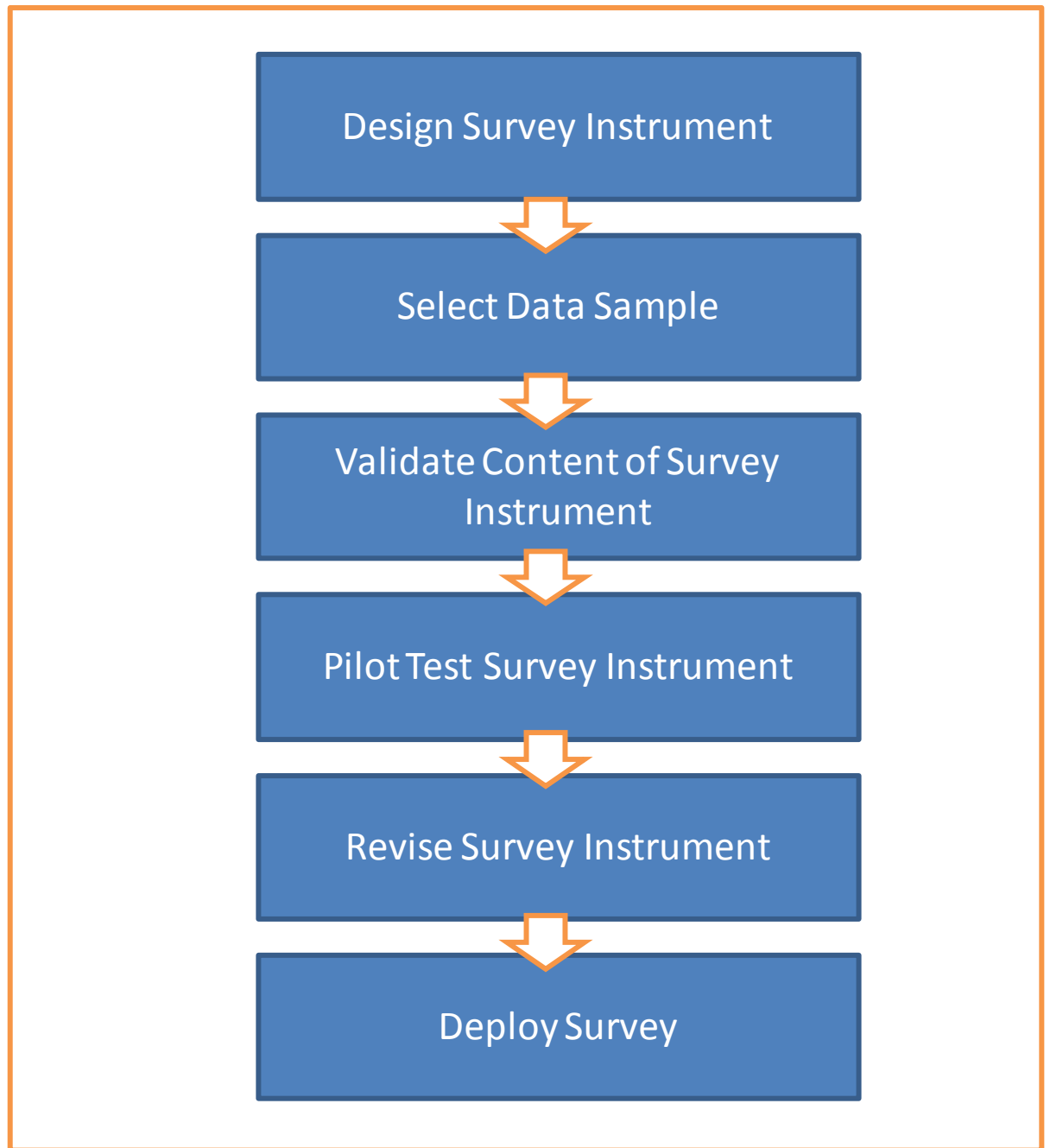


Figure 11: The Survey Design

The following section discusses design considerations and operational procedures of the survey. These considerations of the survey can be broadly classified into two aspects: 1) design considerations applicable to the operationalization of the dimensions and 2) design considerations related to the format of the survey.

The design considerations relating to the operationalization of the Expertise model include:

1. Identifying appropriate constructs and measures of Expertise,
2. Designing appropriate survey question items for the measures of Expertise,
3. Number of survey items per dimension,
4. Wording of survey measures, and
5. Adding appropriate contextual information to amplify the meaning of survey questions.

The design considerations relating to the format of the survey are as follows:

1. Following a consistent design throughout the survey,
2. Sequencing of the Expertise dimensions in the survey instrument,
3. Using a single scale throughout the survey instrument for all dimensions of Expertise and
4. Making all survey questions mandatory for the survey.

The following section discusses each aspect and design considerations of the survey.

Identifying appropriate constructs and measures of Expertise

The focus of the study is to derive expertise measures for the contemporary IS (Enterprise System). There exists no specific model/survey instrument to measure expertise in an enterprise system environment. The constructs of Expertise (Cognitive Competence, Skill-based, Affective and Years of Experience) were developed using a through literature review, yet keeping the underlying theoretical constructs of self-efficacy and user competence. The constructs have been discussed in Chapter 2 (Literature Review) and in the ‘Deriving the a-priori model’ section of this chapter.

Designing appropriate survey question items for the measures of Expertise

Once the dimensions and measures of expertise are determined, corresponding survey question items must be derived. In doing so, it is critical that each measure of expertise is well specified, using guidelines of formative construct specification. Cronbach (1971) and Kerlinger (1964) suggest that an instrument is valid in the content, if that (*instrument*) (i) has drawn representative questions from a universal pool of survey questions, and (ii) subjected to a thorough reviewing process of the items by experts until a formal consensus is reached.

As per literature review, much conceptual work has been done on expertise in referent disciplines, like psychology and sociology. Such literature provided with a generous amount of background literature, which were not considered in past self-efficacy and user competence studies.

Number of Survey Items

Cronbach and Meehl (1955) suggest that the number of items to measure a dimension should adequately sample the domain of interest, but be as parsimonious as possible. Surveys with too many items can induce response pattern bias (Anastasi 1976), however if too few are used, the content and construct validity are compromised (Nunnally 1967). Hinkin and Schriesheim (1989) state that a scale with one-item per dimension would under-specify a dimension. From a different point of view, Ives, Olson et al. (1983) and Bailey and Pearson (1983) proposed a single item per measure in IS measurement studies after considering both theoretical and practical considerations. Moreover, notions of formative constructs too argue that a well-defined single item measures are adequate to measure the sub-constructs of interest.

Wordings of the Survey Questions

All survey questions were designed to gather responses from frequent users of an operational Information Systems. Thus, survey questions do not inquire about respondents' specific work activities relating to SAP Enterprise System, rather makes a reference to their ('your') activities. This was intentionally done to facilitate gathering responses from a large number of respondents using the same survey

instrument. In pilot testing, it was specifically assessed and proven that the instructions provided are adequate in prompting respondents of ‘their’ tasks and work environment. Furthermore, this ‘generalization’ of the questions made the survey instrument easy to complete and comprehend. However, the candidate acknowledges some of the limitations of this approach.

The large number of questions on the expertise model warranted close attention to suitable wording of each question to ensure that all questions gather information only on the assigned measure.

Contextual Information

The survey questions included as much contextual information as possible to minimize potential weaknesses of the generalized questions and to minimize disadvantages of using the deductive survey approach. Question items were designed with the individual perspectives in mind to relate the questions to the respondents and thereby removing any response biasness that comes with ‘here-say’. Furthermore, the survey included an introduction to each success dimension, which made explicit exemplary statements to the sample organizations.

It was also decided to use the term ‘SAP’ as the reference to the Enterprise System, instead of the version release term ‘SAP R/3’ for two reasons. First, SAP now disassociates itself with specific versions and next generation SAP products. Within responding organizations, though it is the same Enterprise System application, there exist different versions of the SAP software. The use of a single term (SAP) in the survey without specific versions eliminated possible confusions of the respondents. Secondly, since there is only one Enterprise Systems application in all the data collection organizations (i.e. SAP), the candidate refrained from using the term Enterprise Systems (or ERP) to generalize the system. The candidate acknowledges the possible confusion between SAP the system and SAP the company. To overcome this possible limited confusion, specific instructions were given in the cover letter stating, “henceforth simply referred to as ‘SAP’ - not to be confused with the *company SAP*”.

Format of the Survey

Having discussed the guidelines and procedures applied to the construct articulation in the survey, the following section summarizes the format and optical design considerations. The survey followed four (4) formatting guidelines and procedures: 1) following a consistent design throughout the survey, 2) sequencing of the expertise dimensions, 3) using a single scale throughout the survey and 4) the use of mandatory questions. The following section briefly describes the four design considerations.

Consistent Survey Format

The survey consists of three (3) main sections. The initial section collected demographic details of the respondent, the second section gathered data on different aspects of expertise and the third section included the IS-Impact measurement model questions. All sections on expertise began with similar guidelines for completion and an introduction of the dimension. No examples were provided. This allowed the respondents to make clearer selections of the measures under investigation. The candidate highlighted several questions where the respondents needed to be extra cautious of the meaning of the survey item.

Sequencing of the Questions

The dimensions were sequenced in a manner that would encourage responding to the survey instrument as well as to stimulate respondent's thinking on deeper issues. Hence, the survey commenced with easy-to-complete demographic details, followed by skill-based and affective related items. The cognitive and knowledge sharing items were positioned last. Pilot testing suggested that respondents require higher level of concentration for answering such questions and alluded to issues when positioning them earlier in the survey instrument.

Use of Single Scale

Using the appropriate scale is another important consideration of the instrument validation process. This refers to the choices a respondent has on answering each item. The most frequently used scale in perceptions gathering surveys is LIKERT scale types, where the respondent chooses a response on a scale. One important

decision regarding the scale selection is pertained to the length of the scale (e.g. 1 to 5; 1 to 7) and usually it is up to the researcher to select the length of a scale. A ‘good’ scale should accommodate sufficient variability among the respondents. According to (Lissitz and Green 1975), reliability of a scale increases with the increments of the number of choices up to five in a scale, but levels off beyond.

A single scale (a seven point LIKERT scale with Strongly Disagree, Neutral to Strongly Agree) was used throughout the survey to reduce the complexity of the survey. Using the seven-point scale is more accurate, and gives much more information to generate statistical measurements of respondent’s attitudes and opinions³. The scale is based on how respondents feel, indicated as: Strongly Disagree, Neutral and Strongly Agree as points 1, 4 and 7 respectively, as seen in Table 7. The advantages that this study identified in employing a single scale throughout the survey include: 1) ease of understanding, 2) ease of completion, 3) minimal instructions, and 4) possibly higher response rate.

| Strongly Disagree | | | Neutral | | | Strongly Agree |
|-------------------|---|---|---------|---|---|----------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Table 7: Scale of agreement

Mandatory Questions

All questions in the survey instrument were made mandatory. However, the data collection procedures did not provide any facility to check completeness of a survey submission. However, endorsement from the senior management and in-person attention to data collection made respondents more attuned to completing the survey instrument without any missing data. In future studies, the candidate recommends a web based data collection with a facility to check the completeness of the responses

³ Also see the report entitled “rating scales can influence results,” Quirk’s Marketing Research Review, <http://www.quirks.com/articles/a1986/19861003.aspx?searchID=4971371&sort=9>

automatically. The complete survey questions used to gauge expertise is appended (see Appendix C).

CONTENT VALIDATION

Research can gather valuable information by conducting a content validity study. Content validation is important to ensure that all individual items of the survey instrument match the intended concepts sufficiently well (Sekaran 2000). Content validity refers to the extent to which the items on a measure assess the same content or how well the content material was sampled in the measure, which can be characterised as face validity. As far as content validity is concerned, and following Bollen (1989) and Schouten et al. (2010), all the items that encompass the constructs in this study result from: 1) a strong review of literature, and 2) face validity.

Strong Literature Review

The greatest care has been taken to ensure that the study responds to the conceptual definitions and that it reflects constructs in the literature. Theoretical papers, including the reference list of the papers, were reviewed to identify the potential determinants and appropriate measures (Schouten, Grol et al. 2010) for our research constructs. This procedure is important for measuring whether all relevant aspects of the constructs are covered. The assessment of scale items should thoroughly, adequately and appropriately represent the concept. This study derived all measures from literature, ensuring the study was strongly grounded in existing theory. The questionnaire is considered to have content validity as its content matches an actual situation that is being studied. The more the measure items represent the domain of the construct, the higher is the scale's content validity (Tiwana 2001).

Face Validation

This study uses face validation to examine the appropriateness of the questionnaire items' soundness, language and appearance. This is essential for validating our survey instrument as to whether it looks valid to the respondents and

whether the language is appropriate to ensure all the questions meet the research objective and can be easily understood by respondents. Previous studies (Lynn 1986; Grant and Davis 1997) recommend a of minimum three experts with a range of up to ten experts depending on the desired diversity of knowledge. Before deploying the survey in this study, this study conducted a pilot test in a representative sample of employees at Pharma 1. The respondents helped to identify problems with wording or meaning, readability, ease of response and content validity (Schouten, Grol et al. 2010).

Minimizing the Common Method Variance

Chang et al. (2010) suggest that researchers should avoid or reduce any potential CMV by constructing variables using information from different sources, and mixing the order of the questions to reduce the likelihood of theory-in-use bias. This procedure is taken to reduce potential bias during our data collection. This study believes that being consistent with the recommended approach enhances the validity of our results.

In developing our survey instrument, the researcher was aware that questions should be short, simple and specific as the wording of questions has an important influence on the responses that are given (Williams, Edwards et al. 2003). Difficult questions may produce inaccurate responses, or the respondents may fail to complete the questionnaire. Following the guidelines, this study designed our survey questions with a consistent format throughout the instrument and logically organised the questions without rigidly following the structure of the research model.

In attention to reducing Common Method Variance, items for expertise, knowledge sharing and IS success were not grouped under their construct headings. This was done to receive a high quality of response as well as to minimise the CMV.

SURVEY POPULATION

It was deemed important that this study gathers data from all frequent Enterprise System users for several reasons; (1) gathering data from more than one cohort allows to internally validate findings of one cohort with another, (2) comparability of findings to demonstrate further justification of the expertise construct, (3) from an Enterprise System success viewpoint, it is essential that all frequent users are canvassed as the success of the system hinges upon strong appropriate use of the system, (4) allows candidate to observe differences in system evaluations across the standard hierarchy of employment as well as the levels of expertise.

The survey was designed to seek opinions and views from all frequent users of SAP. It was important that respondents are direct and regular users of the system. As discussed earlier, it was therefore decided to target all operational and management employment cohorts, leaving out the Strategic Managers and Technical Staff. Technical staff were not included to avoid any possible biasness that they could introduce through their inclination to rate System and Information Qualities as high, given those constructs will be considered as proxy measures of the goodness of the IT departments. Moreover, the sporadic use of the SAP system by the strategic staff was deemed inappropriate for the knowledge of the software aspect in the expertise model. The single, general-purpose instrument accommodates the data collection from the two employment cohorts. A key assumption, which was confirmed later, made in the data collection is that all the respondents are perceived to have adequate knowledge in answering all questions on the status of the Enterprise Systems at the sampled organizations regardless of their involvement with the SAP system.

Survey Administration

Once the pre-pilot survey instrument was finalized, it was pilot tested in a representative sample of employees at Pharma 1. Feedback received from the workshop participants resulted changes to the order of the questionnaire and adding of substantial introductions to each of the main constructs.

The study engaged in a number of supplementary activities to improve responses by (1) obtaining senior management endorsement for the conduct of the survey, and (2) the personal approach in data collection where all surveys were distributed and collected by an employee of the organization. The survey was first introduced to the three organizations in August 2009 and data collection was completed in January 2010.

The Instrument

The survey instrument included three main sections: (1) section 1 on respondent demographics, (2) section 2 on expertise a-priori model dimensions, and (3) section 3 on IS-Impact measurement model questions.

The survey gathered demographic data that are much useful for descriptive and comparative data analysis. The survey gathered demographic information on respondents: 1) employment status, 2) details of their involvement with the SAP system, 3) general employment position description, 4) number of years with the current organisation.

Section two of the instrument included 15 questions pertaining to expertise. The 15 questions in section two included questions to determine the level of expertise of a respondent using; 4 questions of skill-based (proactive self-learning), 5 questions of affective (willingness to adapt), and 6 questions of cognitive competence.

In addition to the 15 measures of expertise, the survey instrument included 38 additional questions: 5 questions on knowledge sharing (our consequence of expertise to test its nomological net. This is discussed in chapter 4.), 27 questions on IS success (to apply expertise construct on IS success), and 6 criterion items (4 for IS success and 2 for expertise). Once the expertise model is specified, this study employed the 'knowledge sharing' construct to further validate the expertise construct in its nomological net (as per formative construct validation guidelines). IS success is

employed to apply the expertise classification that this study will derive to understand whether groupings based on different levels of expertise demonstrate significant differences in their success evaluations. These discussions are forthcoming in chapter 4. The 27 questions on IS success is illustrated in appendix D.

The survey instrument was circulated to all 350 direct operational and management users of the three organizations. Altogether 220 valid responses were captured, yielding a response rate of 63%.

Respondent Anonymity and Confidentiality

An anonymous study is important to guarantee confidentiality so the study team agreed not to reveal the survey information to anyone and promised that nobody would be able to identify who provided the data. For the purpose of follow-up, the study team appointed a questionnaire collector in each organisation. As the questionnaires were handed out personally by the designated person, agreement on our collection schedule was made with the collectors. The study team contacted the collectors and reminded them of the convenient return date as previously agreed.

CHAPTER SUMMARY

This chapter described the research model and data collection methodology. A detailed view of the expertise research model is provided with justifications on each of the salient dimensions. The chapter also described the procedure of the selection of dimensions using referent disciplines and the development of measures using analogous literature from IS discipline. To test the research model and hypothesis, data was collected using the survey technique in a questionnaire format. The survey methodology is discussed in relation to the objectives of the research described in chapter 1. The appropriateness of the survey methodology for this research has been discussed in great detail. This chapter also outlined the detailed attention paid by the candidate in formulating questions, designing the format and in operationalizing the instrument. Therefore, the researcher believes that the validity of the data is satisfactory, and that the data can contribute to strong research findings.

CHAPTER 4: DATA ANALYSIS AND RESULTS

This chapter describes the quantitative analysis including empirical results and hypotheses tests. The chapter is divided into the following sections. The first part focuses on descriptive statistics. In the next section, the structural model including nomological validity is explained. The formative construct validity reported in this chapter follows the accepted guidelines of Cenfetelli and Bassellier (2009) and Klarner et al. (2013). In following their guidelines, first, the inter-construct reliability was established, making sure that items designed and conceived do measure what they are supposed to. Next, the measurement model was established. This determines how the individual items contribute to the formation of the construct. Next, the structural model was tested. The structural model assesses the unique contribution that each construct makes towards expertise. Subsequently this study conducted the “application study” to uncover the findings that are valuable to this research and discuss the research findings.

DATA ANALYSIS DESIGN

The process of the interpretation and evaluation of findings, as illustrated in the research design in Chapter 1, is expanded in more detail in Figure 12. The data analysis design consists of five phases: data preparation, data description, model measurement, content and construct validity, and discussion of findings. Statistical data analysis was performed using the Statistical Package for the Social Science (SPSS) and the nomological net analysis was implemented using smart partial least square (SmartPLS), which adopted the structural equation modelling (SEM) technique.

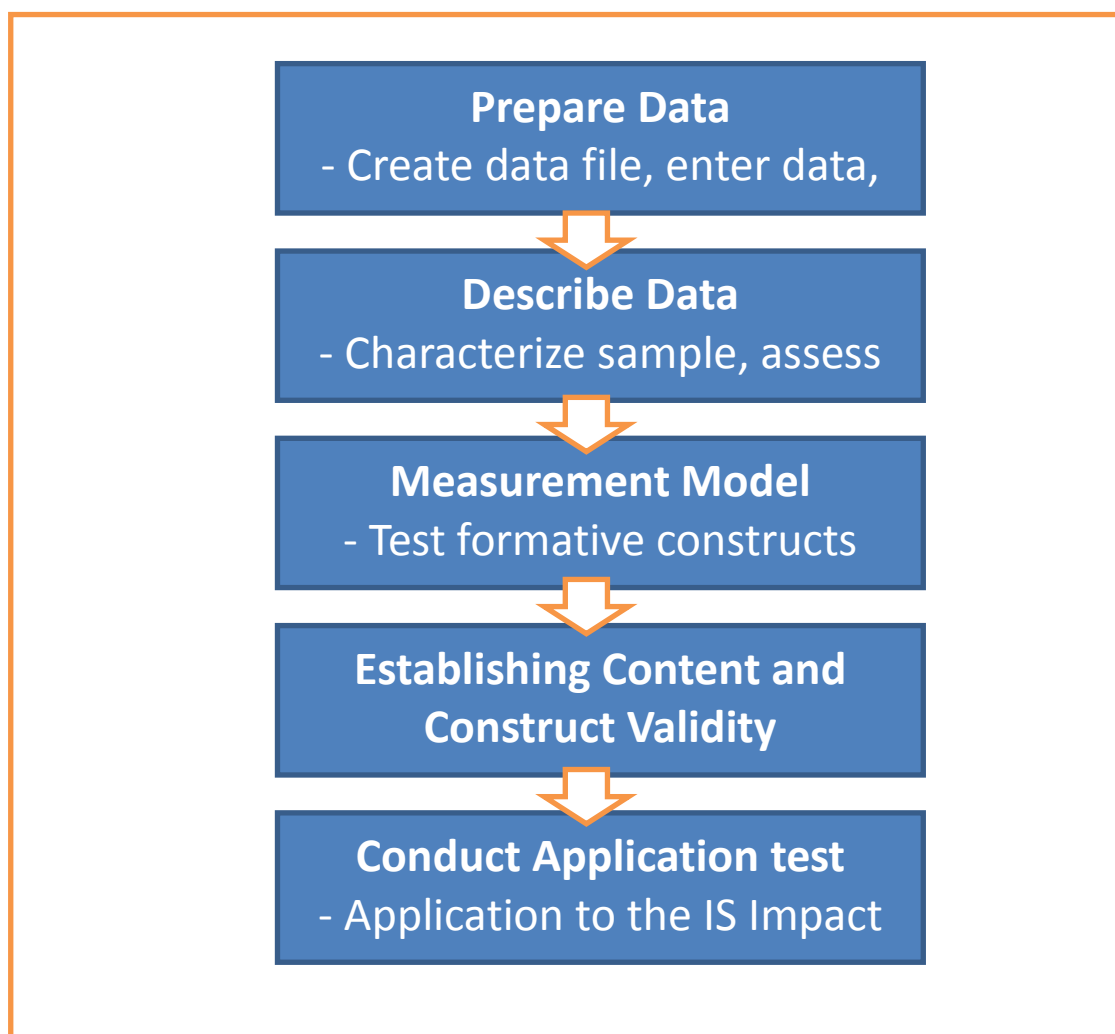


Figure 12: Data analysis design

In the first phase, data was prepared for the analysis. In this step this study created a data file, entered the data and did the cleaning process. In the second phase, data in a manageable form was described. In further detailed analysis, this study

measured the research model by validating the constructs according to the available formative tests. All tests were conducted using SPSS. In the next phase, the study model was tested using content and construct validity tests. Lastly, the three groupings (novice, intermediate and expert) were applied to the IS Impact measurement model to test the hypothesis of this study.

DATA COLLECTION OVERVIEW

Data was collected from 220 daily users of SAP in managerial and operational groups. Three medium sized organisations in India were involved. Only organisations that have implemented an ES were chosen. Also, only the managerial and operational groups were chosen since they are the daily and direct users of the system.

Top management support for all three organisations, were obtained by telephonic conversation and the survey instrument was mailed to them. The survey was distributed to the selected 350 ES users from managerial and operational groups in those organisations. To get a maximum commitment from the respondents, the questionnaires were distributed personally (a chosen individual in each organisation) to the respondents. They collected the completed questionnaires and mailed it to the researcher.

DATA PREPARATION

The study received 225 completed questionnaires, of which 220 were used. The number of completed questionnaires represented an overall response rate of 63 percent which were considered to be a sufficient achievement. The data was prepared in Microsoft excel and then imported to SPSS for analysis.

The survey data was screened for unusual patterns, non-response bias and outliers. The responses were reviewed to determine if the respondents were diligent in completing the questions. Of the 225 responses, 5 were removed because of missing data and perceived frivolity. Removal of these responses left 220 useable surveys. The following sections discuss the analyses in detail through five topics: descriptive

statistics, statistical overview analysis, model assessment overview, the continuum: novice, intermediate and expert, and discussion.

DESCRIPTIVE STATISTICS

This study uses descriptive statistics to describe the basic features of this data. This section outlines the demographic statistics through the classification of employment cohorts, working experience and the data distribution. The intentions of the analysis are: 1) to demonstrate that the sample has all appropriate cohorts to examine expertise across user groups; 2) to show that the sample sufficiently represents the regular ES users; and 3) to reveal that all user groups could be usefully categorised into three groups of expertise. The subsequent sections discuss the descriptive statistics in further detail.

Responses by Employment Cohorts

Table 8 presents the employment cohort demographics of the respondents. The table shows the portion of the respondents in the managerial and operational groups. About 60% of the sample was obtained from the operational group, while 40% were gained from the managerial group. As the data were almost equally obtained from management and operational employees, the respondents can be assumed to be satisfactory for this research due to the typical frequency of ES use among these groups of staff.

| Employment Cohorts | Responses | Percentage |
|--------------------|-----------|------------|
| Managerial | 88 | 40% |
| Operational | 132 | 60% |
| Total | 220 | 100% |

Table 8: Response rate by employment cohort

Mean and Standard Deviation

This section presents the descriptive statistical analysis to describe the characteristics of the sample. Standard deviation is the most common measure of

statistical dispersion, measuring how widely spread are the values in a data set. The purpose of a standard deviation is to express on a standardised scale how different the actual data is from the expected average value. If the data points are all close to the mean, then the standard deviation is close to zero. If many data points are far from the mean then the standard deviation is from zero. If all the data values are equal, then the standard deviation is zero. Table 9 shows the mean and standard deviation values for the individual measures. The standard deviation in Table 9 indicates that all the respondents had responded in a similar way.

| Construct / Measure | N | Mean | St Deviation |
|--|-----|------|--------------|
| Skill-based | | | |
| S1: I regularly refer to corporate database (e.g. intranet) for updates and gain new knowledge of my [name of the business process]. | 220 | 4.56 | 0.44 |
| S2: I regularly observe changes to company policies and guidelines through information repositories relevant to my [name of the business process]. | 220 | 4.86 | 0.46 |
| S3: I try to find better ways of doing my [name of the business process] in the SAP system. | 220 | 5.12 | 0.6.23 |
| S4: I am eager to learn improvements in the SAP system related to my [name of the business process]. | 220 | 4.23 | 0.452 |
| Affective | | | |
| A1:I can easily adapt to any changes to the SAP system required for the [name of the business process]. | 220 | 5.21 | 1.03 |
| A2:I can easily adapt to changes in my [name of the business process]. | 220 | 4.78 | 0.91 |
| A3:I can easily adapt to changes in my department, related to my [name of the business process]. | 220 | 5.12 | 0.91 |
| A4:I can easily absorb any changes in my organizational structure, related to [name of the business process]. | 220 | 5.71 | 1.001 |
| A5: I am ready to accept new roles and responsibilities related to my [name of the business process] when necessary. | 220 | 5.11 | 0.9 |
| Cognitive | | | |
| C1: I fully understand the core knowledge necessary for [name of the business process]. | 220 | 5.16 | 0.89 |
| C2: My knowledge of SAP is more than enough to perform my day-to-day functioning of the [name of the business process]. | 220 | 5.12 | 0.883 |
| C3: I rarely contact SAP helpdesk for software related problems in relation to the [name of the business process]. | 220 | 5.45 | 0.912 |

| | | | |
|---|-----|------|-------|
| C4: I rarely make mistakes when completing my [name of the business process] using SAP. | 220 | 5.34 | 0.901 |
| C5: I have an in-depth knowledge of the functions of the [name of the business process] that I must do on a day-to-day basis. | 220 | 5.55 | 1.012 |
| C6: I have a good knowledge of the organizational goals, procedures and guidelines. | 220 | 5.22 | 0.98 |
| Knowledge Sharing | | | |
| KS1: I regularly share my knowledge of SAP with my colleagues. | 220 | 4.92 | 1.02 |
| KS2: I often suggest improvements of [name of the business process] to my managers / colleagues. | 220 | 4.77 | 0.892 |
| KS3: My colleagues come to me for assistance when they are faced with a work related issue. | 220 | 4.22 | 0.782 |
| KS4: I have colleagues and workmates helping me with using SAP for my [name of the business process] (inversely worded). | 220 | 4.13 | 0.76 |
| KS5: I regularly contribute to knowledge sharing forums within my organization. | 220 | 4.66 | 0.74 |

Table 9: Suitability of the measures

Data Distribution

To determine whether or not the research is normally distributed, the normal probability and scatterplot were examined. All points lie in a reasonably straight diagonal line from the bottom left to top right. This suggests no major deviation from normality. The scatterplot of standardised residuals also shows the same condition.

Non-Response Bias

Non-response bias is a serious concern for studies based on data collected through surveys. Past studies have shown that older persons, women, individuals from upper social classes, and persons with higher education are more prone to return and respond to survey questionnaires. In this study, the non-respondents were sent a reminder email 10 days after the initial surveys were collected. We established that non-response bias is unlikely, given that respondents and non-respondents have almost identical characteristics, where the percentage of management and operational non-respondents were 38% and 62% respectively. Similarly, the average ‘sector-wide’ experience of a non-respondent manager was 14.2 years, while the non-respondent operational staff had 14 years of experience. Respondent operational staff had, on average, 3.2 years of experience, while the non-respondent operational staff

had 3.6 years of average. Therefore, all indicators suggest that the respondent sample is a representative sample of the population.

STATISTICAL ANALYSES OVERVIEW

The data analysis results presented herein; (i) first, validate the formative expertise construct, (ii) employ the expertise construct to derive mutually exclusive groups based on the degree of expertise and (iii) to explore whether those groups derived in step (ii) demonstrate significant differences in relation to their assessment of IS success.

Thus, results of the data analysis are arranged under 3 headings: (i) model and construct validation established through content validity, discriminant and criterion validity, structural model testing and nomological net testing using knowledge sharing as a consequence of expertise; (ii) developing a classification of respondents based on their level of expertise, using two complementary methods – the classical method and cluster analysis; and (iii) application of the model and its expertise groupings on IS success. To the extent that the respondent classification derived in (ii) is meaningful and that the expertise groups (iii) demonstrate significant differences in their success evaluation will provide further validity and reliability to the expertise construct derived in step (i).

Using SmartPLS validation was conducted by measuring the research model. This measurement is used to describe how individual observed constructs load on the research latent constructs (unobserved).

Theoretical Concepts of Formative Constructs

Measures are known as observable indicators or items that are observed through empirical means (Edwards and Bagozzi 2000). Constructs are used to describe a phenomenon that is observable or unobservable, including outcomes, structures, behaviours or other aspects of a phenomenon being investigated (Petter, Straub et al. 2007). The measures are used to examine constructs.

Relationships between constructs and measures need to be evaluated in addition to the structural paths (Edwards and Bagozzi 2000). Because measurement error

impacts on the structural model, misspecification of constructs as formative or reflective affects theory development and prohibits researchers from meaningfully testing theory due to improper results (Petter, Straub et al. 2007). Formative and reflective indicator relationships are relevant in a causal model (Hulland 1999). Reflective indicators or measures are believed to reflect the unobserved, underlying construct, with the current construct causing the observed measures. In contrast, formative measures are defined as the cause of the construct. Reliability and validity are an appropriate assessment for reflective measures. However, this is not necessarily true for formative measures. Infact, formative measures of the same construct can have positive, negative or no correlation with one another (Bollen 1989; Hulland 1999).

Formative constructs are a composite of multiple measures (Petter, Straub et al. 2007) where the changes in the formative measures will cause changes in the underlying construct (Jarvis, MacKenzie et al. 2003). Formative constructs are multidimensional constructs that capture multiple dimensions. Internal consistency or reliability is not important because measures are examining different facets of the construct. Instead, multicollinearity, which is desired among measures for reflective constructs, is a problem for measures of formative constructs (Jarvis, MacKenzie et al. 2003). Multicollinearity is avoided by ensuring that the items do not tap into the same aspects. The measures should not have strong correlations with one another because this suggests multicollinearity (Petter, Straub et al. 2007). According to Jarvis et al. (2003), removing a measure that focuses on a distinct aspect of the construct to improve construct validity will adversely affect content validity. The elimination of an item that is not duplicated elsewhere in the scale could affect whether the construct is fully represented by the measures because the construct is a composite of all the indicators (Petter, Straub et al. 2007).

MODEL ASSESSMENT OVERVIEW

The measurement model analyses the relationship between the latent constructs and their associated items (Chin, Johnson et al. 2008). In further investigation, the overall research model was estimated by using the SmartPLS. SmartPLS is a software

application for the modeling of SEM. To evaluate the partial least square (PLS) estimation, the research follows the suggestions by Chin (1998) and Henseler et al. (2009). The research model (set out in Chapter 3) was tested by examining the magnitude and significance of the structural paths in the PLS analyses and the percentage of the variance explained in the constructs. In the research model, four constructs were modeled as formative. Also, this study tested the nomological net of expertise using knowledge sharing as its immediate consequence.

Establishing Content Validity

Content validity is an important step to ensure the presented indicators capture the entire scope of the construct as described by the domain of the construct (Andreev, Heart et al. 2009). There is no measurement error for the formative structure, but it is essential to minimize disturbance terms by identifying a broad set of indicators that cover all aspects of the construct. Thus, a thorough literature review was conducted related to the construct domain (Straub, Boudreau et al. 2004).

Pilot Testing

Before deploying the survey, this study conducted a pilot test in a representative sample of 21 employees at Pharma 1. The respondents helped to identify problems with wording or meaning, readability, ease of response and content validity (Schouten, Grol et al. 2010).

The following outcomes were observed through pilot testing.

1. In pilot testing, it was specifically assessed and proven that the instructions provided are adequate in prompting respondents of 'their' tasks and work environment. Furthermore, this 'generalization' of the questions made the survey instrument easy to complete and comprehend. However, the candidate acknowledges some of the limitations of this approach.
2. Pilot testing suggested that respondents require higher level of concentration for answering such questions and alluded to issues when positioning them earlier in the survey instrument.
3. An important outcome of pilot testing was the facilitation of content analysis. This study paid close attention to content validity through a thorough literature review that yielded themes and items that appear logical

and consistent with prior research. As a further test of this association of items with constructs and their completeness, the guidelines of McKenzie et al. (1999) were followed for establishing content validity, which entailed four steps⁴: (i) using the guidelines of Lynn (1986), created an initial draft of the survey instrument through canvassing related literature available in self-efficacy and user competence domains deriving the domains / constructs; (ii) following the guidelines of the American Educational Research Association (2002), established a panel of reviewers to evaluate possible survey questions, where a panel had necessary training, experience, and qualifications; (iii) had the panel ('jury') critique the survey constructs (our themes and constructs) – by pilot-testing a sample of respondent staff; and (iv) had the jury conduct a review of the questionnaire, assessing how well each item represented the corresponding dimension. In this fourth step, a quantitative assessment was made, establishing the Content Validity Ratio (CVR) for each item/question based on the formula of Lawshe (1975). Based on 21 pilot tests, the minimum CVR value of .77 was observed at statistical significance of $P < .05$. Feedback from the pilot round respondents resulted in minor modifications to wording of survey items (Lawshe 1975; Lynn 1986; McKenzie, Wood et al. 1999), and endorsement of the model and instrument completeness and association of items with constructs. Using data from the survey, the study next tested the a-priori model and related instrument items for validity.

Establishing Construct validity

According to Bollen (1989), the common way to check the construct validity is to test its convergent and discriminant validity. It is critical to identify whether the constructs that are being used accurately measure the intended concepts before any relationships can be tested. Convergent validity shows that the evaluation relates to

⁴ The four-step approach followed here is analogous to the Q-sort approach suggested by Kendall, K. E., J. R. Buffington, et al. (1987). "The relationship of organizational subcultures to DSS user satisfaction." *Human Systems Management* 7(1): 31-39.

, Kendall, J. E. and K. K. E. (1993). "Metaphors and methodologies: Living beyond the systems machine." *MIS Quarterly* 17(2): 149.

, Tractinsky, N. and S. L. Jarvenpaa (1995). "Information systems design decisions in a global versus domestic context." *MIS Quarterly* 19(4): 28.

for attaining content validity.

what it should theoretically relate to, and therefore whether the scales relate to the items that could be correlated. Discriminant validity is the degree to which two or more measurements designed to measure different theoretical constructs are not correlated. This test estimates the degree to which a measurement scale reflects only characteristics from the construct measured and not attributes from other constructs.

To demonstrate the reliability and validity of the measurement scale, the study undertook specific analyses using SPSS and SmartPLS. The analyses include confirmatory factor analysis for each construct to verify that individual items represent the same theoretical concept. The study tests the hypotheses of the estimated model using path coefficient (correlation), effect size and R^2 , together with statistical significance level from the bootstrapping procedure.

Construct validity for a formative construct can be tested using discriminant validity, convergent validity, external validity and nomological validity. The discriminant validity is used to discriminate between different constructs. The inter-correlations of the model constructs should not be too high (under 0.71) (Andreev, Heart et al. 2009). To establish the nomological validity, the nomological network was used whereby the constructs were linked with the hypothesised consequence construct. Nomological validity is evidenced if the structural path between the latent variable and its consequence is found to be significantly in the expected causality directions (Andreev, Heart et al. 2009).

The expertise model is formative at both construct and measurement levels. This too is consistent with the observations of Marakas et al (2007, p. 21) who state that “...we argue that validation of CSE [computer self-efficacy] and GCSE [general computer self-efficacy] instruments must use techniques appropriate for formative constructs rather than the commonly adopted techniques associated with reflective constructs”⁵.

⁵ See Marakas et al. (2007) for a discussion of why CSE and GCSE constructs must be conceived as formative. Marakas et al. also discuss (table 1, page 20) the key differences between formative and reflective constructs under 4 properties: direction of causality, interchangeability of

The 15 measures of expertise distilled through literature review serve as the starting point for the construction of the formative index for the latent construct under investigation. Note that “Years of experience” measured as a continuous variable, was not included in the analysis of validity and reliability. Following the guidelines of Diamantopoulos and Siguaw (2006), Diamantopoulos and Winklhofer (2001) and Diamantopoulos (2009), this study first tested for multicollinearity amongst the measures. Formative measurement models are essentially based in regression (of the formative construct against its measures). This means that the stability of the coefficients of the measures can be affected by the strength of the measure intercorrelations (and perhaps sample size). Thus, as per (Bollen 1989), excessive collinearity among measures makes it difficult to separate the distinct influence (and hence the validity) of the individual measures on the formative construct. In addition, if a measure is linear (or near-linear) combination of other measures, it would suggest that the indicator is redundant (in the context of the formative construct) and should therefore, in the interests of parsimony, be excluded from the construct⁶.

Investigating Multicollinearity

The internal consistency of the formative construct was performed by a multicollinearity test and test of indicator validity (path coefficient significance) (Petter, Straub et al. 2007). Multicollinearity indicates that the specification of indicators was not accomplished successfully, as high covariance might mean that indicators explain the same aspect of the domain (Andreev, Heart et al. 2009). The magnitude of multicollinearity can be examined by the variance of inflation factor (VIF) and the tolerance value, which is reciprocal of the VIF. The value of $VIF < 10$ shows the absence of multicollinearity. The significance of the path coefficients was statistically tested using a t-test. A test coefficient significance and calculation of the t-statistic were performed by applying the bootstrapping procedure.

Moreover, construct reliability is assessed by examining the loadings of the manifest variables with their respective dimension. A minimum loading cut-off often

indicators/items, covariation amongst indicators, and nomological net. This study employs all of four properties.

⁶ The candidate acknowledges that some (e.g. Bollen and Lenox (1991) as cited in Petter et al. (2007) suggest retaining non-significant indicators in attention to completeness and content validity.

employed is to accept constructs with loadings of 0.70 or more, which implies that there is more shared variance between the dimension and its manifest variable than error variance (Kaiser 1974; Carmines and Zeller 1979; Hulland 1999; Dwivedi, Choudrie et al. 2006).

Multicollinearity exists when the independent variables are highly correlated. The stronger the correlation, the larger the standard estimation error. This will result in larger confidence intervals and the parameters for the independent variables are more likely to be insignificant. Multicollinearity exposes the redundancy of variables and the need to remove variables from the analysis. There are various ways to obtain the multicollinearity. Some factors might come from improper use of variables or inclusion of a variable that is computed by other variables in the equation. The degree of multicollinearity among the formative indicators needs to be assessed by calculating the variance of inflation factor values or the tolerance values.

The other multicollinearity assessment is the value of tolerance, a measure of collinearity that is reported by SPSS. A small tolerance value indicates that the variable under consideration is almost a perfect linear combination of the independent variables in the equation. Tolerance is an indicator of how much of the variability of the specified independent variable is not explained by the other independent variables in the research model. If the value is less than 0.1 (close to zero), it should be investigated further. This is because this very small value indicates that the multiple correlation with other variables is high, which suggests a possibility of multicollinearity (Pallant 2005). Table 10 below shows the VIF values.

The VIF statistic was used to determine if the formative indicators were too highly correlated. This is because, if the multicollinearity between the construct indicators is too high, it can destabilize the research model (Roberts and Thatcher 2009). The maximum VIF value for the construct of Skill-based came to 2.45. The VIF values for the constructs of Affective ranged from 2.34 to 4.2, Cognitive ranged from 1.10 to 4.1, and Knowledge sharing ranged from 1.39 to 2.67. All values are well below the threshold of 10, as suggested by the traditional rule of thumb. This indicates that there is no threat to the validity in these constructs.

| Construct / Measure | VIF |
|--|------------|
| Skill-based | |
| S1: I regularly refer to corporate database (e.g. intranet) for updates and gain new knowledge of my [name of the business process]. | 2.11 |
| S2: I regularly observe changes to company policies and guidelines through information repositories relevant to my [name of the business process]. | 2.45 |
| S3: I try to find better ways of doing my [name of the business process] in the SAP system. | 1.34 |
| S4: I am eager to learn improvements in the SAP system related to my [name of the business process]. | 1.14 |
| | |
| Affective | |
| A1: I can easily adapt to any changes to the SAP system required for the [name of the business process]. | 3.12 |
| A2: I can easily adapt to changes in my [name of the business process]. | 4.2 |
| A3: I can easily adapt to changes in my department, related to my [name of the business process]. | 2.34 |
| A4: I can easily absorb any changes in my organizational structure, related to [name of the business process]. | 3.56 |
| A5: I am ready to accept new roles and responsibilities related my [name of the business process] when necessary. | 2.67 |
| | |
| Cognitive | |
| C1: I fully understand the core knowledge necessary for [name of the business process]. | 4.1 |
| C2: My knowledge of SAP is more than enough to perform my day-to-day functioning of the [name of the business process]. | 3.74 |
| C3: I rarely contact SAP helpdesk for software related problems in relation to the [name of the business process]. | 2.34 |
| C4: I rarely make mistakes when completing my [name of the business process] using SAP. | 1.103 |
| C5: I have an in-depth knowledge of the functions of the [name of the business process] that I must do on a day-to-day basis. | 4.01 |
| C6: I have a good knowledge of the organizational goals, procedures and guidelines. | 3.13 |
| | |
| Knowledge Sharing | |
| KS1: I regularly share my knowledge of SAP with my colleagues. | 2.34 |
| KS2: I often suggest improvements of [name of the business process] to my managers / colleagues. | 2.13 |

| | |
|--|------|
| KS3: My colleagues come to me for assistance when they are faced with a work related issue. | 2.67 |
| KS4: I have colleagues and workmates helping me with using SAP for my [name of the business process] (inversely worded). | 1.56 |
| KS5: I regularly contribute to knowledge sharing forums within my organization. | 1.39 |

Table 10: Validity test for formative constructs

Structural Model Assessment Using Partial Least Squares

The research model was analysed and interpreted using the PLS technique in two parts. In the first part, the measurement research model (outer) was tested by performing both validity and reliability analyses. The test examined the reliability of composite individual measures, known as composite reliability (CR); and (ii) the convergent validity of the measures, through Average Variance Extracted.

In the second part, the structural model (inner) was tested by estimating the paths between the constructs in the model to determine the significance as well as the predictive ability of the model. With the analysis of the measurement model completed, the structural model of the relationships between the various latent constructs was analysed. To determine the significance of the paths, the results of the bootstrapping 400 re-sampling technique was run in PLS. All the paths were significant, which indicates that the research model is empirically confirmed by the data. Table 11 displays the results of the structural model testing of the research model.

The individual path coefficient of the PLS structural model can be interpreted as standardised beta coefficients of ordinary least square regressions. The structural paths provide a partial empirical validation of the theoretically assumed relationships between latent variables (Henseler and Fassott 2009). To determine the confidence intervals of the path coefficients and statistical inference, the re-sampling technique of bootstrapping is used (Tenenhaus, Vinzi et al. 2005). This research used the PLS technique to validate the structural model and to test the hypothesised relationships as this procedure is able to model latent construct conditions of small to medium sample size (Limayem, Khalifa et al. 2004). The result shows how well the measures relate to each construct and whether the hypothesised relations as discussed in the previous

sections are empirically true. It also provides more accurate estimates of the paths among constructs that may be biased when using a multiple regression technique. Tests of significance for all paths were conducted using the bootstrap re-sampling method

As suggested by Diamantopoulos and Winklhofer (2001, p. 272), this study employed a global item that “summarizes the essence of the construct that the index purports to measure” and examine the extent to which the items associated with the index correlate with this / these global item/s. For this purpose, this study employed the two criterion measures of expertise that were included in a separate section of the survey instrument⁷ as listed below. It is also noted that the first criterion item reflects a quasi third party evaluation of expertise (See appendix C for the survey items and figure 1 for the measurement approaches).

- “In my organization, my colleagues recognize me as someone with high expertise [of the business process]”
- “I believe that I have a high level of expertise based on my skills, abilities and knowledge [of the business process]”

Correlating the 15 items with the two global measures demonstrated significant correlation coefficients at the 0.001 level.⁸

The study model, now including the years of experience, is next tested using the Partial Least Squares (PLS) procedure (Wold 1989), and employing the SmartPLS software (Ringle 2005). PLS facilitates concurrent analysis of (i) the relationship between constructs and their corresponding constructs and (ii) the empirical relationships among model constructs. The significance of all model paths was tested with the bootstrap re-sampling procedure (Gefen, Straub et al. 2000; Petter, Straub et al. 2007). Table 11 reports the outer model weights, outer model loadings, and t-statistics. From table 11 it is observed that, with the exception of years of experience, loadings are generally large and positive, with each dimension contributing significantly to the formation of each construct.

⁷ The two criterion measures were included at the end of the instrument, separate from other items, in attention to minimizing possible common method variance.

⁸ It is noted that a single reverse-coded item was appropriately correlate negatively with the criterion items.

| | | Outer Weights | | Outer Loadings | |
|------------------|---------------------|---------------|--------|----------------|--------|
| | | Weights | T-stat | Loadings | T-stat |
| Expertise | Affective | 0.42 | 9.09 | 0.90 | 32.13 |
| | Skill-Based | 0.35 | 8.27 | 0.87 | 30.34 |
| | Cognitive | 0.26 | 7.88 | 0.84 | 21.21 |
| | Years of Experience | -0.01 | 0.12 | 0.05 | 1.20 |

Table 11: PLS statistics

Table 11 results establish convergent and discriminant validity of the model constructs. Convergent validity of cognitive competence, affective and skill-based confer to heuristics of Gefen and Straub (2005), where all t-values of the Outer Model Loadings exceed 1.96 cut-off levels⁹ significant at 0.05 alpha protection level. The t-values of the loadings are, in essence, equivalent to t-values in least-squares regressions. Each measurement item is explained by the linear regression of its latent construct and its measurement error (Gefen and Straub 2005). However, loading for ‘years of experience’ was weak and insignificant.

Structural Model Testing

Finally, this study assessed the formative variables, focusing on the nomological aspects, by linking the index to other constructs with which it would be expected to be linked. PLS estimates the path model for each bootstrap sample. The statistical significance of the parameter estimates were determined by a bootstrapping procedure. The bootstrap method has been used for assessing the performance of a regression model, to predict error of the model, and allows assessment of the statistical significance of the regressors (Austin and Tu 2004). The PLS results for all bootstrap samples provide the mean value and standard error for each path model coefficient (Henseler and Fassott 2009). In this study, bootstrapping was used to create 400 sub-samples. T-values that were obtained from the bootstrapping procedure correspond to various inner and outer model paths. The significant values were then calculated using the extracted T-values.

A summary of the result is shown in Figure 13. The significant path is indicated with an asterisk (*).

According to Jarvis et al. (2003), these other constructs can be either antecedents or consequences of the phenomena under investigation¹⁰. Thus, consistent with Jarvis et al. (2003) and Bagozzi (1994), and with the (third) guideline of Diamantopoulos and Winklhofer (2001) for validating formative constructs in a nomological network, this study next tested the relationship between expertise and ‘knowledge sharing’ as one of its immediate consequences.

The précis below of knowledge sharing is not intended to provide an in-depth overview of knowledge sharing and its associations with expertise, rather to present the argument for this seemingly tautological scenario where experts share knowledge with their peers. Numerous studies note that managing knowledge, where knowledge sharing is an essential part of, is imperative to ES success (e.g. Pan, Newell et al. 2007; Sedera and Gable 2010). Studies of several disciplines; IS (e.g. Bender and Fish 2000; Swap, Leonard et al. 2001), business (e.g. Gregan-Paxton and John 1997), and psychology (e.g. Boose and Bradshaw 1987; Hinds 1999; Bartol, Durham et al. 2001); suggest that experts, are willing, able and motivated to convey their superior knowledge and skills to novices. The reflective measures of knowledge sharing were developed using literature review and are listed in Appendix C.

Figure 13 depicts the structural model with path coefficient (β) between Expertise and knowledge sharing, R^2 for knowledge sharing significant level of 0.05 alpha. Supporting our prepositions, further validating the construct, results show that expertise is significantly associated with knowledge sharing (path coefficient (β) = 0.602, $p < 0.005$, $t = 14.21$); the squared multiple correlation coefficient (R^2) of 0.34 indicating that expertise explains 34% the variance in the endogenous construct.

¹⁰ Bagozzi, R. (1994). Structural equation models in Marketing Research: Basic Principals. *Principals in Marketing* R. Bagozzi. Oxford, Blackwell: 317-385.

suggests, “After all, the substantive reason behind index construction is likely to be how the index functions as a predictor or predicted variable” (p. 332).

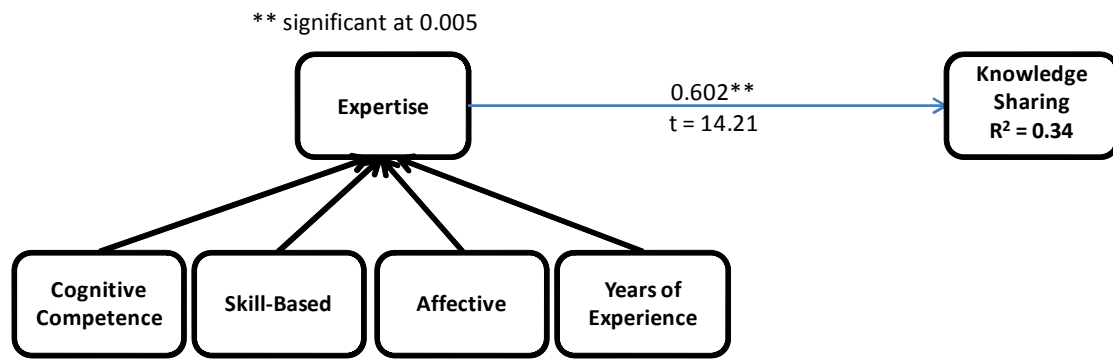


Figure 13: Structural Model

In summary, our results of the analyses confirm the validity and reliability of our measurement of expertise, using cognitive competence, affective and skill-based constructs. However, despite its prominence in related past literature as a determining factor of one's expertise, 'years of experience' does not make a significant contribution to the expertise of an IS user. This may be attributed to the dynamic nature of contemporary Enterprise Systems, where the pace of technology evolution outstrips expertise gained through years of experience. It appears that, unless other criteria are fulfilled, one's years of experience solely does not contribute to one's expertise of IS. On the other hand, 'affective' construct is the single strongest indicator of IS expertise, highlighting the importance of socio-behavioural characteristics of expertise. Cognitive competence, though significant and substantial, makes a 'lesser' contribution compared with 'affective' and 'skill-based' constructs.

THE CONTINUUM: NOVICE, INTERMEDIATE AND EXPERT

Having validated the constructs and measures of the expertise model, this study now attempts to group respondents of the survey according to their degree of expertise. This study follows a common and simple classification of expertise, where a user can be placed in a continuum based on their expertise: (i) novice, (ii) intermediate and (iii) expert (Eriksson and Charness 1994; Hinds 1999). To classify respondents of the survey, this study employs two separate methods to derive the classification of expertise. Method 1 –the classical method – has been employed in the past in socio-psychology studies (Ericsson and Smith 1991; Hunt 2006; Norman 2006; Yates and Tschirhart 2006). Method 2, exploratory in nature, employs a cluster analysis to uncover natural groupings of respondents based on their expertise.

Method 1 – The Classical Method

Anecdotal evidence (and common sense) suggests that an expert would have ‘better’ knowledge, skills and adaptability as compared to an intermediate or a novice. Yet, the boundary between these three groups is less clear. Social science research employs the classical approach to group respondents using standard deviations and mean scores of a construct. Here, a respondent is considered as an ‘expert’, if the respondent’s mean for the measurement construct is above the sum of standard deviation and mean of the sample for the measurement construct. Similarly, a respondent is considered a novice, when the respondent’s mean is less than the subtraction of standard deviation from the mean of the sample.

Applying this notion to this study constructs, this study first calculates the mean scores of each constructs, for every respondent. Next, the sample mean and sample standard deviation are calculated for construct. The classification in table 12 is derived using the following simple equations: Novice = Respondent’s mean_{construct} < (sample mean_{construct} - sample standard deviation_{construct}), while an Expert = Respondent’s mean_{construct} > (sample mean_{construct} + sample standard deviation_{construct}). The remainder are considered intermediates. Table 12 shows the expertise classification derived for each of the 4 constructs. Furthermore, this study derives a ‘composite construct of expertise’ using the three variables of Affective, Cognitive and Skill-based. This was deemed appropriate as the constructs were conceived as formative and can be added to derive the overarching construct of expertise. The composite classification is next employed to compare results in the forthcoming cluster analysis.

| | Affective | | Cognitive | | Skill-Based | | Composite | | YoE | |
|---------------------|-----------|-----|-----------|-----|-------------|-----|-----------|-----|-----|-----|
| | # | % | # | % | # | % | # | % | # | % |
| Novice | 33 | 15% | 30 | 14% | 30 | 15% | 31 | 15% | 21 | 10% |
| Intermediate | 175 | 80% | 180 | 81% | 171 | 80% | 175 | 80% | 165 | 75% |
| Expert | 12 | 5% | 10 | 5% | 19 | 5% | 14 | 5% | 34 | 15% |

Table 12: Results of Classification Method One

The distribution of percentages arrived using the classical method for the groupings of novice, intermediate and experts is almost identical across the three

salient variables of expertise (with ~15% of novice, 80% of intermediates and 5% of experts).

Method 2 – Cluster Analysis

The objective of cluster analysis is to explore whether measurement items lead to a *natural* classification of expertise. Through step-wise clustering¹¹ on the criterion item – “In my organization, my colleagues recognize me as someone with high expertise” – yielded a three cluster solution, with the goodness of cluster quality indicating ‘good’¹² – where cluster 1 having 30 respondents, cluster 2 with 176 respondents and cluster 3 with 14. Intrigued by the three cluster solution, this study then seeks a relationship between the composite result of Method 1 and results of Method 2. Here, this study compared the results of method 1 and method 2, record-by-record for each respondent. This study observed that respondents in cluster group 1 matching 99% with respondents in composite group (using method 1) Novice, 100% matching with Intermediates and 100% matching with results of Experts. This high overlaps between results of method 1 (composite) and method 2 provides further strength to our classification of respondents and in turn on constructs and measures of expertise.

Application of Expertise Classification

Having arrived at an expertise classification to groups respondents into three groups based on their expertise, this study now explores whether the experts, intermediates and novices demonstrate significant differences in their evaluation of their ES. The reasons for selecting IS success as the ‘application’ area are several; (i) the natural alliance between success evaluation and expertise, where in practice,

¹¹ Literature suggests the use of step-wise clustering (against other methods like K-means, Hierarchical clustering) in instances where the objective is more exploratory, than confirmatory Punj, G. and D. W. Stewart (1983). "Clustering in Marketing Research: A Review and Suggestions for Application." Journal of Marketing Research **10**(May): 134-148.

¹² As stated earlier, this criterion item relates to a quasi third-party evaluation of one’s expertise (akin to observer evaluation method of expertise in figure 1).

‘expert views’ are frequently sought in system evaluations, (ii) respondents having different views is a key notion purported in IS success studies, yet according to many, a concept that is under investigated (e.g. Cameron and Whetten 1983; Grover, Jeong et al. 1996; Seddon, Staples et al. 1999) and (iii) the popularity of IS success studies (e.g. DeLone and McLean 2003; Sabherwal, Jeyaraj et al. 2006; Gable, Sedera et al. 2008; Petter, DeLone et al. 2008) suggesting that this application is relevant and meaningful to a greater community. To measure IS success, this study employs 27 measures of the IS success model of Gable Sedera and Chan (2008) in Appendix D and was collected using respondents of the survey. The Gable et al. (2008) IS Success model too is conceptualized as a formative, multidimensional index comprised of four dimensions – Individual Impact, Organizational Impact, System Quality and Information Quality. This multidimensional conception of success has garnered some endorsement in recent literature; in example, Petter et al. (2008) cite Gable et al. (2008) model as one of the most comprehensive, and comprehensively validated IS success measurement models to-date.

In order to explore the purported differences in perceptions in relation to the four dimensions of system success across the three groups of expertise continuance, a series of independent sample t-tests were conducted. Table 13 shows results of the independent sample t-tests for the aggregated IS success constructs.

| | Information Quality | System Quality | Individual Impact | Organization Impact |
|-------------------------|---------------------|---------------------|---------------------|---------------------|
| | Sig / t-value* | Sig / t-value* | Sig / t-value* | Sig / t-value* |
| Expert Vs. Novice | 0.02 / -2.41 | 0.01 / -2.86 | 0.01 / -3.35 | 0.03 / -1.89 |
| Expert Vs. Intermediate | 0.01 / -2.85 | 0.86 / 0.25 | 0.00 / -4.41 | 0.03 / -2.65 |
| Intermediate Vs. Novice | 0.02 / -2.38 | 0.10 / -.58 | 0.01 / -2.41 | 0.02 / -2.39 |
| * significant at 0.05 | | | | |

Table 13: Results of the independent sample t-tests

From table 13 the significant differences between the Experts, Intermediates and Novices, in relation to Information Quality, System Quality, Individual Impacts and Organization Impacts (with the exception of System Quality) are showed. These

observed differences concur with our preposition that users with different levels of expertise evaluate the same system differently.

CHAPTER SUMMARY

This study sought to conceptualize, measure and apply the notion of Contemporary Information Systems User Expertise. Our discussion on the conceptual framework highlighted the need to revisit the notions of user expertise in Contemporary IS. Most past studies of computer self-efficacy and user competence focus on function IT (e.g. spreadsheets and word processing as common examples), highlighting the need to re-conceptualize user expertise of a complex, contemporary, and organizational-wide Information System (where Enterprise System is an archetype of). As Marakas, et al. (2007) highlight “...for business and information systems, real world tasks are neither simple nor single domain focussed. Rather, they often draw on multiple skill sets and require an individual to be able to perform tasks that span several skill domains... (p.40)”. Our conceptualization, measurement and application of Contemporary Information Systems User Expertise are driven to address this gap in research.

This research conceived both the model constructs and its measures as formative, manifested in extensive attention to the completeness and necessity of constructs and measures of expertise. In order to ensure this, the expertise model specification and validation proceeded from an inclusive view of expertise, commencing with the three theoretical foundations of theories of learning (Kraiger, Ford et al. 1993), employed in past studies. Conceived primarily through a ‘system centric’ viewpoint, the study presented a conceptual framework for which IS expertise can be understood (figure 1 in Chapter 1).

The literature review identified the constructs of expertise, consistent with past studies. Conceptual arguments that drew on past research, combined with this citation analysis, suggested the sufficiency of the three constructs to develop specific measures for contemporary IS user expertise. This study also included years of experience, purely as an exploratory exercise to test its relevance and its contribution to contemporary Information Systems user expertise. The a-priori model was tested using survey data of 220 operational and managerial users representing three SAP using companies, conforming to all formative data analysis techniques, corroborating

evidence of multiple data analysis methods. In addition, this study investigated the nomological relationship between expertise and one of its immediate consequences of knowledge sharing – demonstrating further validity of our expertise construct.

This study next sought to derive a simple, yet useful classification of expertise. The study classified the respondent sample into three groups based on expertise, employing the classical method using standard deviations and mean scores and method 2 employing an exploratory cluster analysis, yielding almost identical results. The classification of user expertise into three groups, by itself useful, provides further credibility to the constructs and measures of our expertise model. Next, this study applied the expertise model and the classification of users in IS success domain, exploring whether experts, intermediates and novices perceived their information system success differently.

CHAPTER 5: CONCLUSIONS, IMPLICATIONS AND LIMITATIONS

This chapter summarizes the research related works, and outlines possible contributions, limitations and suggests follow-on works. It begins with a summary of the research, and subsequently addresses the generalizability of the findings. It is then followed with a discussion on the major implications for both research and practice. Next, limitations of the research are summarized and possible future research directions are addressed. The section on future research provides alternative methods to strengthen the findings of this research and explains additional related research questions that might be addressed with new methods and new data.

RESEARCH SUMMARY

This study sought to conceptualize, measure and apply the notion of Contemporary Information Systems User Expertise. The discussion on the conceptual framework highlighted the need to revisit the notions of user expertise in Contemporary IS. Most past studies of computer self-efficacy and user competence focus on function IT (e.g. spreadsheets and word processing as common examples), highlighting the need to re-conceptualize user expertise of a complex, contemporary, and organizational-wide Information System (where Enterprise System is an archetype of). As Marakas et al. (2007) highlight “...for business and information systems, real world tasks are neither simple nor single domain focussed. Rather, they often draw on multiple skill sets and require an individual to be able to perform tasks that span several skill domains... (p 40)”. The conceptualization, measurement and application of Contemporary Information Systems User Expertise in this study are driven to address this gap in research.

The main hypothesis of the study is that Information Systems users have significantly different levels of expertise, and that they can be usefully classified according to their degree of proficiency. Thus, this study expected, if the derived classification is correct and meaningful, the evaluations that they make of a system are also significantly different.

The study design and the research model have been derived to accommodate the hypothesis.

Through the driving research hypothesis, two research questions are derived:

- (1) What are the salient characteristics of user expertise in Information Systems?
- (2) Do respondents of different levels of expertise demonstrate statistically significant differences in their system evaluations?

The answer to the first research question was achieved through the development of an expertise measurement model, which led to the derivation of a classification method that can be used to understand expertise cohorts. Once the expertise characteristics were determined and the cohorts were identified, the study next sought

whether these cohorts (based on expertise) do hold statistically different views in relation to their assessment of system success.

This research commenced by placing notions of existing studies of user Expertise, Computer Self Efficacy, and user competence on a theoretical framework. This placement of past study constructs against the theoretical boundaries assisted the current study to understand where the present weaknesses are and how the study can be placed to develop a study model based on prepositions of a contemporary IS. The current study proposed figure 1, conceived primarily through a ‘system centric’ viewpoint, to drive the arguments of the current study as well as to determine opportunities for future studies (See discussion in relation to figure 1).

Once the boundaries of the current research were established through a system related point of view, the study next developed the constructs necessary to measure cognitive competence, skill-based and affective constructs. The current study herein employs the learning theory, self efficacy theory, expertise constructs employed in social psychology and the concepts of user competence were employed. Specifically, the overall framework for the study was derived through the concepts of learning theory proposed by Kraiger, Ford et al. (1993). The result of this phase was an appropri model with four constructs. This research conceived both the model constructs and its measures as formative, manifested in extensive attention to the completeness and necessity of constructs and measures of expertise. In order to ensure this, the expertise model specification and validation proceeded from an inclusive view of expertise, commencing with the three theoretical foundations of theories of learning (Kraiger, Ford et al. 1993), employed in past studies.

Next the measures for the four constructs were derived through literature. The study developed a 22 item scale to measure the four constructs of the expertise model (skill-based, affective, cognitive, knowledge sharing) and the antecedent of expertise (in this study knowledge sharing). The instrument also included two items that were designed as criterion measures. All 22 items used the Likert scale ranging from 1-7. Though the items are grouped under its construct in Appendix C for the reviewer’s convenience, the actual survey instrument did not group or label the items to minimize common method bias.

In addition to the 22 items, the study survey instrument included 2 items to measure experience of the respondent, both at the organization as well as in the industry sector.

Furthermore, 31 items of the IS Impact Measurement model was included to measure IS success. IS Impact model and its measures were employed to see whether the three respondent cohorts (grouped according to their level of expertise) provide different views in relation to the four dimensions of IS Success. Given the relatively similar contexts of the current study and the study that derived the IS Impact measurement model (i.e. Enterprise Systems, similar lifecycles and same user group), the current study did not re-validate the measures of the measures of the IS Impact model dimensions.

The primary observations gathered through the literature review of the measures and constructs provided, qualified the constructs and measures of the current study. Conceptual arguments that drew on past research suggested the sufficiency of the three constructs to develop specific measures for contemporary IS user expertise. The study also included years of experience, purely as an exploratory exercise to test its relevance and its contribution to contemporary Information Systems user expertise. The a-priori model was tested using survey data of 220 operational and managerial users representing three SAP using companies, conforming to all formative data analysis techniques, corroborating evidence of multiple data analysis methods. In addition, the study investigated the nomological relationship between expertise and one of its immediate consequences of knowledge sharing – demonstrating further validity of the expertise construct.

The current study next sought to derive a simple, yet useful classification of expertise. The study classified the respondent sample into three groups based on expertise, employing the classical method (method 1) using standard deviations and mean scores and method 2 employing an exploratory cluster analysis, yielding almost identical results. The classification of user expertise into three groups, by itself useful, provides further credibility to the constructs and measures of our expertise model. Next, the study applied the expertise model and the classification of users in IS success domain, exploring whether experts, intermediates and novices perceived their information system success differently.

| Research Questions | Research Method | Outcome | Where reported? |
|--|-------------------|--|-----------------|
| What are the salient characteristics of user expertise in Information Systems? | Literature Review | The literature review derived the study constructs and related measures of the expertise model | Chapter 2 |
| | | A conceptual framework was designed to identify the focus of the study context | Chapter 3 |
| | Survey | The survey tested the a-priori model with a sample of 220 respondents | Chapter 4 |
| | | Discriminant validity was established using PLS and SPSS | Chapter 4 |
| Do respondents of different levels of expertise demonstrate statistically significant differences in their system evaluations? | Survey | Respondents were grouped based on their expertise, into three groups using Cluster Analysis | Chapter 4 |
| | | Respondents were grouped based on their expertise, into three groups using the Standard Deviation Method | Chapter 4 |
| | | Respondent groups demonstrated statistically significant differences for the dimensions of IS Impact model | Chapter 4 |

Table 14: Research Questions, Method and Where reported

In summary, this study, model and approach contribute to several areas (relevant stages of the study indicated in parentheses).

This research:

1. provided a system centric conceptual framework to measure user expertise, (the framework of expertise),
2. developed new measures in attention to contemporary Enterprise Systems, exceeding past notions of computer self-efficacy and user competence (the framework, literature review where the constructs and measures were qualified),
3. conceived and tested the expertise model as a formative model, using strict guidelines of formative construct validation (survey and related analysis),
4. established a generalizable classification of expertise using two complementary methods (developing the expertise continuum), and
5. demonstrated the application and usefulness of such a classification for system evaluations (application in IS success).

Moreover,

6. in attention to calls by researchers (e.g. Marakas, Johnson et al. 2007, p.40) to use ‘real data’ using ‘real world tasks’ to develop a better understanding of competence of users¹³, all study phases were conducted using ‘real data’ from respondents from three companies using the SAP Enterprise System.

¹³ Recognizing that most past studies focussing on user competence and self-efficacy had employed classroom experiments using college graduates.

IMPLICATIONS

This study makes several strong implications to both research and practice. Such contributions can be discussed under several headings: (1) implications by identifying characteristics necessary to assess expertise of end user of a contemporary Information System, (2) implications of this classification to system success / evaluation studies, (3) implications to the methodology and (4) implications to practice. The section below provides the discussion for each of these points.

Implications of the characterization and classification

The current study validates constructs to measure expertise in a contemporary IS context. Despite years of work on analogous topics on user competence, computer self efficacy and on expertise itself, how does this research add value? Marakas et al (2007) make several observations and guidelines for future studies. First, they suggest that there is a severe dearth of studies of this nature in the area of contemporary IS. Yet, to-date, there are no studies on investigating expertise in contemporary IS. As outlined by McAfee (2006) there are substantial differences between what he calls as Network IT, Function IT and Enterprise IT. To date, as highlighted in Marakas et al. (2007), there have not been any studies of User Competence, Self Efficacy and Expertise in the Enterprise IT domain. The main differences between Enterprise IT, where ERP, ES are archetypes of, and Function IT (where most, if not all studies of User Competence and Self Efficacy had been) are mostly surrounding the steep and radical changes to 'Learning' that end users undergo throughout the lengthy and continuous lifecycle changes. Such changes to learning and the levels of knowledge are not evidence in relation to the Function IT systems. Moreover, performance / productivity of an employee in relation to a Function IT (i.e. MS Word) do not get impacted through his or her affective characteristics. Whereas the organizational challenges and changes that employees face with Enterprise IT require that they be more affective and proactive in learning, in addition to their knowledge or core competencies. In fact, this study demonstrated that most of the variance of the expertise construct is explained by the 'affective' construct.

Therefore, to the extent that the expertise model and its constructs are robust across other contemporary systems, contexts, and lifecycle phases, user expertise may serve as a validated dependent / mediating / moderating variable in ongoing research.

Next, the classification method that this study derived provides a tentative guideline on how one could identify an expert in an organization. It is tentative, because the current guidelines require further validation in diverse circumstances. It is noted that all current methods for identifying expertise in Enterprise IT are based on 'classical methods'. In other words, most organizations conduct 'tests' to understand user knowledge. Such tests are skewed highly towards 'product knowledge' and do not project the true picture of an expert in an organizational IS.

Similarly, past methods for classifying respondents based on expertise did not provide clear cut-off values for self-evaluated respondents. The classification schema triangulated through the criterion measures and standard deviations provide a clear cut-off values that can be employed in future studies.

Implications to system success studies

This research employed IS success as a domain of research to understand how / whether users with diverse levels of expertise view success of an operational IS differently. The IS Impact measurement model of Gable Sedera and Chan (2008) was employed herein, with all its constructs and measures for this purpose. As discussed in chapter 3, the current study re-validates the constructs and measures of the IS impact model in a new context. This brings further credibility to the model, and extends its generalizability.

The aforementioned is a substantial contribution to the discipline of IS success, where a validated model of success has been re-validated in its entirety in a new context, retaining all of its constructs and measures.

Similarly, the study results demonstrate that those with diverse levels of expertise perceive system success differently. For decades of IS success research that contributed a wealth of research contributions, this finding means that success differs on the evaluator's perspective. Though the same message was echoed by Cameron and Whetton (1983), where they identified the 'perspective of success' as a major

question that must be considered in evaluations, this has been largely ignored in IS success studies that have primarily focussed on construct validation.

Implications to the methodology

There are two key contributions from the current study to the methodology: (1) how the application area has been employed, (2) derivation of the classification schema using cluster analysis.

First, most studies in the domain of expertise or system success seek a causal / process relationship. Such studies typically study the relationship between constructs using such methods like regression, correlation and /or partial least squares. This study approach of using IS success construct is unique, in that the study employed IS success as the ‘application area’ for the findings identified through the expertise model.

Second, IS researchers seldom employ Cluster Analysis techniques. The application of cluster analysis herein demonstrates exploratory aspects where such analysis could add further benefit.

Implications to Practice

For the practice, our study makes several contributions. First, (i) This study provides a meaningful way of understanding expertise in a contemporary IS. (ii) Practitioners could employ the model to emulate ‘expert qualities’ to assist novices and intermediates to perform at higher levels and ultimately become experts. (iii) It too highlights that, since one’s IS expertise does not necessarily depend on their innate abilities and years of experience, thus, productivity improvements sought through IS can be achieved by appropriate interventions. (iv) This study also highlighted, that any program geared toward improving performance would require interventions focussed not only on enhancing systems related skills, but on more behavioural aspects (in this study Motivation and Skill-Based). Finally, (iv) for those practitioners engaged in system evaluations, this study provides evidence that experts, intermediates and novices perceive system success differently. The four practical considerations are elaborated below.

First, for the practice, deriving constructs that describe one's expertise will provide a meaningful way of understanding expertise in a contemporary IS. The current understanding of expertise is highly focussed on cognitive skills of an employee. This heavy dependence on cognitive skills in current thinking is particularly true for the operational staff. This study demonstrated that, though the cognitive skills are important, motivational and skill-based constructs make a better contribution to describing the expertise construct.

Practitioners could employ the model to emulate 'expert qualities' to assist novices and intermediates to perform at higher levels and ultimately become experts. Having understood the constructs and their relative contributions to expertise, practitioners could emulate strengths of an expert to develop encouragement behaviours for intermediates and novices. Especially, we conceive each construct to be *formative*, with a set of minimum number of measures for each construct. Akin to its original intent, the formative measurement provides "specific and actionable attributes" of a concept (Mathieson et al. 2001), which is particularly interesting from a practical viewpoint. In formative measurement, the weight of a single indicator can be used to draw practical implications on the importance of specific details and therefore guide practical enforcement on these expertise characteristics. Another possibility of modeling 'actionable attributes' would have been the use of multi-dimensional constructs, where the first order constructs (the dimensions) can be measured reflectively (see also, Wixom and Todd 2005).

As an independent variable, user expertise may aid in understanding the groups in an organization, user expertise measure may lead to a complete measure of user quality. Though the results are heartening, measures developed in this study must be tested for their utility in other contexts and provide the foundation for deriving new measures in other research contexts (e.g. customer relationship management systems, early lifecycle phases).

It too highlights that, since one's IS expertise does not necessarily depend on their innate abilities or years of experience, thus, productivity improvements sought through IS can be achieved by appropriate interventions. In prior literature, there has been much focus on years of experience as a strong contributor to expertise. To the contrary, this study found that years of experience is non-significant and does not

make any contribution to either operational or management staff levels. This could be attributed to the dynamism of the Information Systems discipline, where the evolution of the system outperforms the capabilities derived through years of experience.

This study also highlighted, that any program geared toward improving performance would require interventions focussed not only on enhancing systems related skills, but on more behavioural aspects (in this study affective and skill-based). For those practitioners engaged in system evaluations, this study provides evidence that experts, intermediates and novices perceive system success differently.

LIMITATIONS AND EXTENSION

Despite having extended the rigorous study approach and despite the validity demonstrated, this study recognized three main limitations of the study model requiring attention beyond the scope of this study.

First, the data collection method may be perceived as a limitation of the study. The study model was developed and validated with data collected from only three organizations, using the same Enterprise System (i.e. SAP) representing the same industry sector (i.e. manufacturing). The homogeneity of the context helped the study validate the measures, without the effect of extraneous variables – yet, it may raise questions about whether the initial list of constructs and measures used in the development of the a-priori model was complete and representative of contemporary IS in general, and whether the final list of measures and constructs are, indeed, generalizable.

Second, the measurement items of the constructs of expertise were derived through a literature review. In retrospect, the study model could have been more robust, had it included an additional content validation mechanism. For example, the study model could have included a construct identification and validation case study. Yet, given that the study results indicate a high percentage of variance explained through the expertise model suggest that the constructs were reasonably measured. In relation to item design, one could also avoid the use of the terms “rarely” and /or “regularly” (Mooi and Sarstedt 2011). This would further improve the validity of constructs.

Third, though the study was ‘by-design’ scoped to address the areas marked as ‘B’ in the conceptual framework (see chapter 1), it would have been best to have conducted the study over multiple axis for comparative purposes. This would have helped increase generalizability of the findings. Future studies could benefit by doing this. For example, future studies could extend the evaluation method to both self-evaluation as well as classical method.

In conclusion, an extensively validated and widely-adopted IS expertise model would facilitate cumulative research, while providing a benchmark for organizations to track their user expertise. This study results offer a significant step in this direction.

APPENDICES

Appendix A – System Classifications

To demonstrate the differences between the types of systems, we employ McAfee (2006). The table below, derived using McAfee (2006), compares the three types of systems.

| Category | Function IT | Network IT | Enterprise IT |
|-------------------------------------|--|---|--|
| Definition | Assists with the execution of discrete tasks | Facilitates interactions without specifying their parameters | IT that specifies business processes |
| Characteristics | Can be adopted without complements. Impact increases when complements are in place | Does not impose complements, but lets them merge over time Does not specify tasks or sequences Accepts data in many formats Use is optional | Imposes complements throughout the organization. Defines tasks and sequences Mandates data formats. Use is mandatory |
| Examples | Spreadsheets, computer aided design, statistical software | Emails, instant messaging, wikis, blogs and mash-ups | ERP, CRM and SCM |
| Automation | Some degree of automation (e.g. Spell check) | Very low level of automation | High level of automation |
| Key-User-Groups | More likely to have a single Key-User-Group | More likely to have a single Key-User-Group | Multiple Key-User-Group using the same system very differently |
| Considerations for Expertise | Most users would remain proficient with the basic system features Potential to improve performance through deeper and exploratory use | Limited work-oriented functionality Access to system features is equal across all key-user-groups Depth of use would not result in substantial improvements | High automation of business processes Many key-user-groups have different types of uses Must consider mandatory and non-mandatory uses For processes with high automation, frequency of use will only provide |

| | | | |
|--|--|--|----------------------------|
| | | | observations of efficiency |
|--|--|--|----------------------------|

We outline four salient differences between Enterprise IT (EIT) and Function IT (FIT) along the following aspects that justify the need to develop a better understanding for Enterprise IT expertise.

1. **Enterprise IT cannot be adopted without complements:** Complements are defined by McAfee (2006; p 142) as “organizational innovations or changes”. Examples of complements that allow performing technologies include ‘re-design of processes’ and ‘new decision rights’. Thus, McAfee argued that Function IT (e.g. word processing) can be adopted by the user without any substantial organizational innovation, changes and the use of Function IT does not entail process re-designs or new decision rights (as opposed to Enterprise IT).
2. **Contextual changes vary the way we use Enterprise IT:** Enterprise IT require that users apply the functionality of the system based on the organizational circumstances, while the use of Function IT is fairly static. For example, SAP software will be ‘configured’ as per the organizational requirements and the different configurations are likely to be different from one business process to another. Therefore, an Enterprise IT user faces a range of options in their business process executions, where the process of execution depends on his/her organizational knowledge, business process knowledge and or knowledge of the system features. For example, when procuring material for the organization, a user must know the organization specific purchasing strategies, whether to create a purchase order using a contract or requisition, and how to select the best vendor through a vendor evaluation completed through the system. Such process oriented variances in tasks require far deeper knowledge of the system, business processes and organization specific procedures.
3. **Prior knowledge is essential:** Another difference between Function IT and Enterprise IT relates to the extent of prior knowledge and exposure (familiarity) that users could employ in determining their expertise. Unlike Function IT, users seldom have prior knowledge and prior use in relation to Enterprise IT. Given the proliferation of word processing and spreadsheet applications at the individual/personal levels, users are knowledgeable about Function IT applications before using at a work place. This also means that users of Function IT in general have similar expertise throughout their use of an application – whereas, the users of Enterprise IT will have different levels of expertise.
4. **Proficiency changes over time / across user cohorts:** We acknowledge that users could gain improved expertise in Function IT over a period of extensive use. For example, a user of a spreadsheet application may also spend time observing (learning), adapt to changes of new versions, and perhaps even

make fewer mistakes in using them. Yet, the differences between a ‘novice’ user and an ‘experienced’ user in Function IT is minimal. Moreover, the degree of proficiency required by each key user group (i.e. operational staff, managers and strategic) too is substantially different for Enterprise IT. Whereas in Function IT, user expertise of an application (e.g. for word processing) largely remains the same across multiple user groups.

Appendix B – IS Success studies

| No | Study | Existing Employment Cohorts | | | | | No | Study | Existing Employment Cohorts (Cont.) | | | | |
|----|--------------------|-----------------------------|------|-------|------|------|----|------------------------|-------------------------------------|------|-------|------|------|
| | | Stra. | Man. | Tech. | Ope. | Ext. | | | Stra. | Man. | Tech. | Ope. | Ext. |
| 1 | (Igbaria 1990) | | X | X | | | 42 | (Livari 1997) | | | X | | |
| 2 | (Conrath 1990) | | | X | | | 43 | (Lu 1997) | | | X | | |
| 3 | (Nabili 1991) | | X | | | | 44 | (Ang 1997) | X | X | X | X | |
| 4 | (Guimaraes 1991) | | X | X | | | 45 | (Koh 1998) | | | X | | X |
| 5 | (Higby 1991) | X | X | | | X | 46 | (Segars 1998) | X | X | | | |
| 6 | (Watson 1991) | X | X | X | | X | 47 | (Essex 1998) | | | | X | |
| 7 | (Joshi 1992) | X | X | X | | X | 48 | (Yuthas 1998) | | | | | X |
| 8 | (Pearson 1992) | X | X | X | X | | 49 | (Gelderman 1998) | | X | X | X | X |
| 9 | (Udo 1992) | | X | | | | 50 | (Raghunathan 1999) | | | X | | |
| 10 | (Raymond 1992) | | X | | | | 51 | (Doolin 1999) | | | | X | |
| 11 | (King 1992) | X | X | | | X | 52 | (Sethi 1999) | | | | X | |
| 12 | (Lee 1992) | | X | X | | | 53 | (Jiang 1999) | | X | | | |
| 13 | (Adams 1992) | X | X | | | | 54 | (Burn 2000) | | X | X | | |
| 14 | (Lawrence 1993) | X | X | | | | 55 | (Venkatesh 2000) | | | | X | |
| 15 | (Szajna 1993) | | | | | X | 56 | (Rawstome 2000) | | | | X | |
| 16 | (Oz 1993) | | | | | X | 57 | (van der Heijden 2000) | | | X | | |
| 17 | (Miller 1993) | | X | X | | | 58 | (Pawlowski 2000) | | | X | | |
| 18 | (Seddon 1994) | | | | X | | 59 | (Forgionne 2000) | | | | | X |
| 19 | (Gatian 1994) | | X | X | | | 60 | (Ravichandran 2000) | X | | | | |
| 20 | (Premkumar 1994) | X | X | X | | | 61 | (Skok 2001) | | X | | X | X |
| 21 | (Doll 1995) | | X | X | X | | 62 | (Fok 2001) | | X | | | |
| 22 | (Palvia 1995) | | X | X | X | | 63 | (Wixom 2001) | X | X | | X | |
| 23 | (Yoon 1995) | | X | X | X | X | 64 | (Rai 2002) | | | | X | |
| 24 | (Young 1995) | X | X | X | X | X | 65 | (Xiao 2002) | | | | | X |
| 25 | (Yoon 1995) | X | X | X | X | X | 66 | (Torkzadeh 2002) | | | | | X |
| 26 | (Nord 1995) | X | X | | | | 67 | (Gelderman 2002) | | X | | | |
| 27 | (Jones 1995) | X | | X | | | 68 | (Umble 2002) | | X | | | |
| 28 | (Rainer 1995) | | | X | X | X | 69 | (Jiang 2002) | X | X | | | |
| 29 | (Amoli 1996) | | X | X | X | X | 70 | (Crowston 2003) | | | X | | |
| 30 | (Saarinen 1996) | | | X | | | 71 | (Byrd 2003) | | X | X | | X |
| 31 | (Guimaraes 1996) | | X | X | X | | 72 | (Hung 2003) | X | X | X | | |
| 32 | (Vandenbosch 1996) | | X | | | | 73 | (Nevo 2003) | | | X | | |
| 33 | (Leidner 1996) | | X | | | | 74 | (Bhatt 2003) | | | X | | |
| 34 | (Dennis 1996) | | | | X | X | 75 | (Negash 2003) | | | | | X |
| 35 | (Choe 1996) | | | X | X | | 76 | (Sedera 2004) | X | X | X | X | |
| 36 | (Thong 1996) | | X | | | | 77 | (Bharati 2004) | | | | | X |
| 37 | (Walstrom 1997) | X | | | | | 78 | (Subramani 2004) | | X | | | |
| 38 | (Harrison 1997) | X | X | X | X | | 79 | (Ong 2004) | | | X | | |
| 39 | (Igbaria 1997) | X | X | | X | | 80 | (Barua 2004) | | X | | | |
| 40 | (Dekleva 1997) | | | X | | | 81 | (Tanriverdi 2005) | X | X | | X | |
| 41 | (Li 1997) | | X | X | X | | | | | | | | |

Appendix C – Expertise Survey Instrument

SKILL-BASED [PROACTIVE SELF LEARNING]

S1: I regularly refer to corporate database (e.g. intranet) for updates and gain new knowledge of my [name of the business process].

S2: I regularly observe changes to company policies and guidelines through information repositories relevant to my [name of the business process].

S3: I try to find better ways of doing my [name of the business process] in the SAP system.

S4: I am eager to learn improvements in the SAP system related to my [name of the business process].

AFFECTIVE [WILLINGNESS TO ADAPT]

A1: I can easily adapt to any changes to the SAP system required for the [name of the business process].

A2: I can easily adapt to changes in my [name of the business process].

A3: I can easily adapt to changes in my department, related to my [name of the business process].

A4: I can easily absorb any changes in my organizational structure, related to [name of the business process].

A5: I am ready to accept new roles and responsibilities related to my [name of the business process] when necessary.

COGNITIVE COMPETENCE [KNOWLEDGE REQUIREMENTS]

C1: I fully understand the core knowledge necessary for [name of the business process].

C2: My knowledge of SAP is more than enough to perform my day-to-day functioning of the [name of the business process].

C3: I rarely contact SAP helpdesk for software related problems in relation to the [name of the business process].

C4: I rarely make mistakes when completing my [name of the business process] using SAP.

C5: I have an in-depth knowledge of the functions of the [name of the business process] that I must do on a day-to-day basis.

C6: I have a good knowledge of the organizational goals, procedures and guidelines.

KNOWLEDGE SHARING

6. I regularly share my knowledge of SAP with my colleagues.

7. I often suggest improvements of [name of the business process] to my managers / colleagues.

8. My colleagues come to me for assistance when they are faced with a work related issue.

9. I have colleagues and workmates helping me with using SAP for my [name of the business process] (inversely worded).

10. I regularly contribute to knowledge sharing forums within my organization.

EXPERTISE CRITERION ITEMS

1. In my organization, my colleagues recognize me as someone with high expertise.
2. I believe that I have a high level of expertise based on my experience, skills, abilities and knowledge.

Appendix D – IS Success Items

(From Gable et al. (2008; p 405))

Individual-Impact is concerned with how [the IS] has influenced your individual capabilities and effectiveness on behalf of the organization.

1. I have learnt much through the presence of [the IS].
2. [the IS] enhances my awareness and recall of job related information
3. [the IS] enhances my effectiveness in the job
4. [the IS] increases my productivity

Organizational-Impact refers to impacts of [the IS] at the organizational level; namely improved organisational results and capabilities.

5. [the IS] is cost effective
6. [the IS] has resulted in reduced staff costs
7. [the IS] has resulted in cost reductions (e.g. inventory holding costs, administration expenses, etc.)
8. [the IS] has resulted in overall productivity improvement
9. [the IS] has resulted in improved outcomes or outputs
10. [the IS] has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth, etc.)
11. [the IS] has resulted in improved business processes
12. [the IS] has resulted in better positioning for e-Government/Business.

Information-Quality is concerned with the quality of [the IS] outputs: namely, the quality of the information the system produces in reports and on-screen.

13. [the IS] provides output that seems to be exactly what is needed
14. Information needed from [the IS] is always available
15. Information from [the IS] is in a form that is readily usable
16. Information from [the IS] is easy to understand
17. Information from [the IS] appears readable, clear and well formatted
18. Information from [the IS] is concise

System-Quality of the [the IS] is a multifaceted construct designed to capture how the system performs from a technical and design perspective.

19. [the IS] is easy to use
20. [the IS] is easy to learn
21. [the IS] meets [the Unit's] requirements
22. [the IS] includes necessary features and functions
23. [the IS] always does what it should
24. The [the IS] user interface can be easily adapted to one's personal approach
25. [the IS] requires only the minimum number of fields and screens to achieve a task
26. All data within [the IS] is fully integrated and consistent
27. [the IS] can be easily modified, corrected or improved.

IS-Impact (criterion measures)

28. Overall, the impact of SAP [Financials] on me has been positive.
29. Overall, the impact of SAP [Financials] on the agency has been positive.
30. Overall, the SAP [Financials] System Quality is satisfactory.
31. Overall, the SAP [Financials] Information Quality is satisfactory.

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